Review Article

Acupuncture and Herbal Medicine

OPEN

Trigger points and sensitized acupoints: same book, different covers?

Mingsheng Sun[1], Mingxiao Yang[2], Jing Rong[1], Xingsha Ma[1], Hui Zheng[1], Dingjun Cai[1], Ling Zhao[1,*], Fanrong Liang[1,*]

Abstract

Acupoints and trigger points in traditional Chinese medicine represent two different minimally invasive therapy systems-based, respectively, on traditional acupuncture and dry needles. Many studies argue that trigger points and traditional acupoints are conceptually similar because they generally have identical locations on the human body. However, whether trigger points contribute to the formation of the traditional acupuncture technique is controversial. Although many relevant studies have been conducted, this controversy continues to hinder the development of both disciplines. Recently, researchers of Chinese acupuncture have proposed the "acupoint sensitization" theory, which postulates that traditional acupoints may be sensitized by diseases, environments, and therapies. This turns them into a "sensitized state." Recent studies suggest that trigger points and sensitized acupoints share similar biological properties. To clarify the above-mentioned confusion, we reviewed relevant studies on these two concepts and attempted to analyze their relationship. In this paper, we provide a general summary of acupoint sensitization theory and sensitized acupoints. We then compare trigger points with sensitized acupoints by categorizing their similarities and differences, including location and range, pathological morphology, pain perception, surface temperature effects, and bioelectrical properties. We believe that, because trigger points and sensitized acupoints have many shared properties, they might constitute "the same book with different covers."

Keywords: Acupoint sensitization, Biological characteristics, Trigger points

1 Introduction

In 2017, the American Alliance for Professional Acupuncture Safety published a white paper on dry needling (DN) and acupuncture[1–3] that states that DN is an integral part of traditional acupuncture. However, there is much dispute among scientific researchers over whether DN is a part of traditional acupuncture. This is an old debate that has hindered the development of both disciplines. The white paper thoroughly analyzed the similarities and differences between DN and acupuncture from different aspects, such as intervention methods and stimulation locations. Prior to that, extensive comparisons had been made between trigger points (TrPs) and traditional acupoints[4–10]. Some experts consider that TrPs are acupoints[11] whereas others think that the two terms might be identical and used interchangeably in regards to anatomy[12–13]. Still more, other groups believe that the terms were derived from vastly different concepts[14].

Previous studies have discussed the differences between TrPs and acupoints, but they focused mainly on the correlation between location and anatomy. The similarities in their biological and functional characteristics have received less attention compared to their relationship with sensitized acupoints (SeAs). Thus, the controversy remains unsolved.

The sensitization of acupoints stems from a cutting-edge theory proposed recently in the field of acupoint specificity, which is a special subfield of acupoints. Many studies on acupoint sensitization are available; they propose that the acupoints have plasticity[15] that could better guide clinical diagnosis and treatment. The potential features of the acupoint sensitization process have considerable similarities with the biological and functional characteristics of TrPs. We extensively and comprehensively searched two English electronic databases (Medline and Embase) and two Chinese databases (CNKI and CBM) to collect potential literatures from their inceptions to July 2021. This review aims to provide a renewed understanding of the relationship between TrPs and acupoints (Figure 1).

2 Concepts of TrPs and SeAs

2.1 Trigger points

TrPs are the main stimulation points in DN. They are derived mainly from pain-sensitive points identified in modern medical research. They also represent points on the surface of the body that have a decreased pain threshold. TrPs were defined by Stedman as specific points that could feel pain from palpation or when pressure is applied on the body[16]. TrPs are a kind of local hypersensitive tender point located in the palpable taut bands of skeletal muscles[14] and are often associated with visceral[17] and myofascial pain[18]. When pressure is applied, they cause a feeling of local pain or referred pain from a distant area.

Mingsheng Sun and Mingxiao Yang contributed equally to this work.

[1] College of Acupuncture and Tuina, Chengdu University of Traditional Chinese Medicine, Chengdu, China; [2] Memorial Sloan Kettering Cancer Center, Bendheim Integrative Medicine Center, New York, USA

[*] Corresponding author. Ling Zhao, College of Acupuncture and Tuina, Chengdu University of Traditional Chinese Medicine, Chengdu 610075, China, E-mail: zhaoling@cdutcm.edu.cn; Fanrong Liang, College of Acupuncture and Tuina, Chengdu University of Traditional Chinese Medicine, Chengdu 610075, China, E-mail: acuresearch@126.com.

Acupuncture and Herbal Medicine (2021) 1:2

Received 10 August 2021 / Accepted 22 November 2021

http://dx.doi.org/10.1097/HM9.0000000000000018

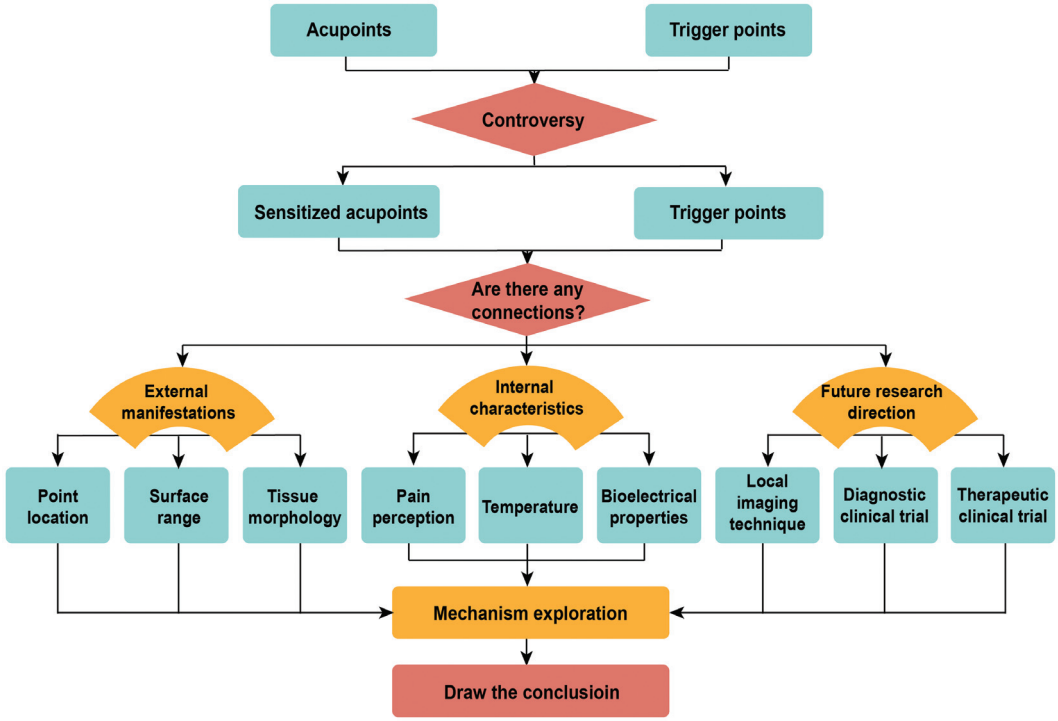

Figure 1. Research idea diagram.

2.2 Sensitized acupoints

An acupoint reflects the body's internal organs and meridians of the *qi*, invisible vital energy in traditional Chinese medicine (TCM) theory that performs in special parts of the body surface. According to TCM theory, acupoints are reflection points of diseases and the main locations for treatment[19]. Studies have shown that acupoints can be sensitized and are able to change in function and size; they have the functional characteristic of being able to switch from a relatively silent state to a relatively active state[15,20–21]. Based on this, the Chinese acupuncture research community proposed the sensitized acupoints theory. The manifestation of acupoint sensitization is that relevant acupoints exhibit biological characteristics, such as an expanded acupoint area, decreased pain threshold, abnormal temperature, and lowered bioelectrical resistance. Our latest study described the characteristics of elevated skin temperature at SeAs in patients with knee osteoarthritis[22].

3 Pathophysiologic mechanisms of TrPs and SeAs

3.1 Location and range

There are overlaps between TrPs and acupoint locations on the body surface. Travell and Simons[14] systematically cataloged 255 common TrPs in the 1980s, which promoted the recognition and popularization of TrPs. By comparing acupoints with TrPs, Dorsher[23] found a 95% overlap between the points used in acupuncture and DN to treat painful diseases. In addition, the location and range of myofascial pain were associated closely with the distribution of meridians, with an overlap of 90%. In further research, they examined acupoints and the muscles located within a 2-cm range around TrPs; they found that in 255 common TrPs, 238 (93.3%) of them anatomically mapped to acupoints[12–13]. They identified a number of pain indications (up to 97%) and somatovisceral indications (up to 93%) of common TrPs that anatomically correspond to classical acupoints. Acupoints and TrPs tend to have the same positions and anatomical structures, which can be interpreted according to potential neural mechanisms that could form the structural basis of how TrPs are similar to SeAs.

Some studies suggest that the effective area of TrPs and SeAs can expand. Melzack et al.[24] compared 56 TrPs with traditional acupoints that are used primarily to treat local pain. They found that all 56 TrPs were within 3 cm of the acupoint, and about 71% of TrPs had the same pain indications as the acupoints. The reason for this deviation might be that the study compared TrPs with non-SeAs rather than SeAs. Studies have shown that activating TrPs extends the range of tenderness[25–26], with the area within 2 cm of TrPs presenting a low pain threshold. Qi et al.[20] found that the range of sensitized traditional acupoints could be extended to 2 *cun* (about 4 cm) depending on disease conditions. The extended SeAs may be related to the expansion of ectopic synapses[15]. Our clinical study of 916 patients with knee osteoarthritis confirmed the expansion of the SeA range, which is manifested mainly by a relative tendency of the pain-sensitive points to concentrate around acupoints[27]. Thus, TrPs and SeAs were not located at fixed points but were distributed in a certain area; the range of TrPs and SeAs can expand similarly. Research has demonstrated that the receptive field of dorsal horn neurons can expand after prolonged strong stimulation of the receptive field of acupoints[28–29].

TrPs are likely to contribute to the spatial spread of pain and hyperalgesia of generalized stress, and active TrPs are associated with muscle nociception. Activation of painful activity from TrPs in the dorsal horn neurons leads to sensitization of the central nervous system, which causes hyperalgesia and pain to appear. Therefore, the pain

spreads to the remote and greater regions of the body, and is not limited to local tenderness at the trigger point[30]. The cause for the widening of the painful, sensitive areas of TrPs and SeAs might be centralized sensitization.

3.2 Tissue morphology

The change in tissue morphology of TrPs on the body surface is almost consistent with SeAs. TrPs are nodules with morphological changes. *The Myofascial Pain and Dysfunction: Trigger Point Manual*[31] states that TrPs are attached to a response (pain) point where muscle strength is not completely fixed[32–34]. These points are described as "highly hyperirritable spots around skeletal muscle fascia," and are associated with palpable nodules in taut bands of muscle fiber.

Acupoints have two major functions: diagnosis and treatment. The diagnostic function of acupoints relies mainly on the change of acupoint morphology. This function reflects not only limb (external) diseases but also visceral (internal) diseases. When the body is in the disease state, there are several morphological developments in SeAs, such as nodules, pimples, uplift, dimplings, and skin color changes[35–36] (Figure 2).

TrPs and SeAs can also reflect both external and internal diseases[9,17]. Using ultrasonography[37–39], the tissue around TrPs was shown to be thicker and harder, compared with the surrounding normal tissue. Scholars of acupoint studies have reported tissue thickening around SeAs as well[40–41]. These changes may be the results of distinctive organized structural changes in TrPs and SeAs. Hudspith et al.[42] demonstrated that visceral and somatic nociceptive inputs converge on the same dorsal horn neurons and reflexively cause somatic muscle spasms (subcutaneous or muscle induration). Receptive field stimulation can extend the receptive field of dorsal horn neurons[43]. These results suggest that the neurons of the dorsal horn are central to the widening of the distribution range and changing of the morphological structures of TrPs and SeAs.

3.3 Pain perception

TrPs and SeAs seem to be involved in the mechanism that reduces the pain threshold and leads to pain sensitivity. Pressure pain is one of the main manifestations of TrPs[44]. In 1988, Fisher created measurement methods and tools (pressure instruments) to determine the pain threshold of TrPs and quantify the pain threshold. Many researchers have used this method to study TrPs and acupoints. The evaluation of TrPs by this pressure instrument has demonstrated that it is a highly sensitive and reliable tool[45–46].

It has been argued that the relationship between mutual pain and external pressure on TrPs is linear; that is, the increase in pressure is directly proportional to the increase in pain[47]. However, this relationship showed non-linear in normal muscle. Usually, the pain will increase until a threshold is reached with normal muscle pressure. When the pressure pain thresholds (PPT) of TrPs and non-TrP areas were compared[48–50], researchers found that the pain threshold of TrPs was significantly decreased[51], and more sensitivity to pain was found in TrPs compared to the surrounding tissues[44].

Researchers also measured the PPT of acupoints. The results indicated that, in patients, the PPTs are significantly different in SeAs versus non-SeAs or in SeAs versus non-acupoints. However, the PPTs were roughly similar in acupoints versus non-acupoints in healthy controls[52–53].

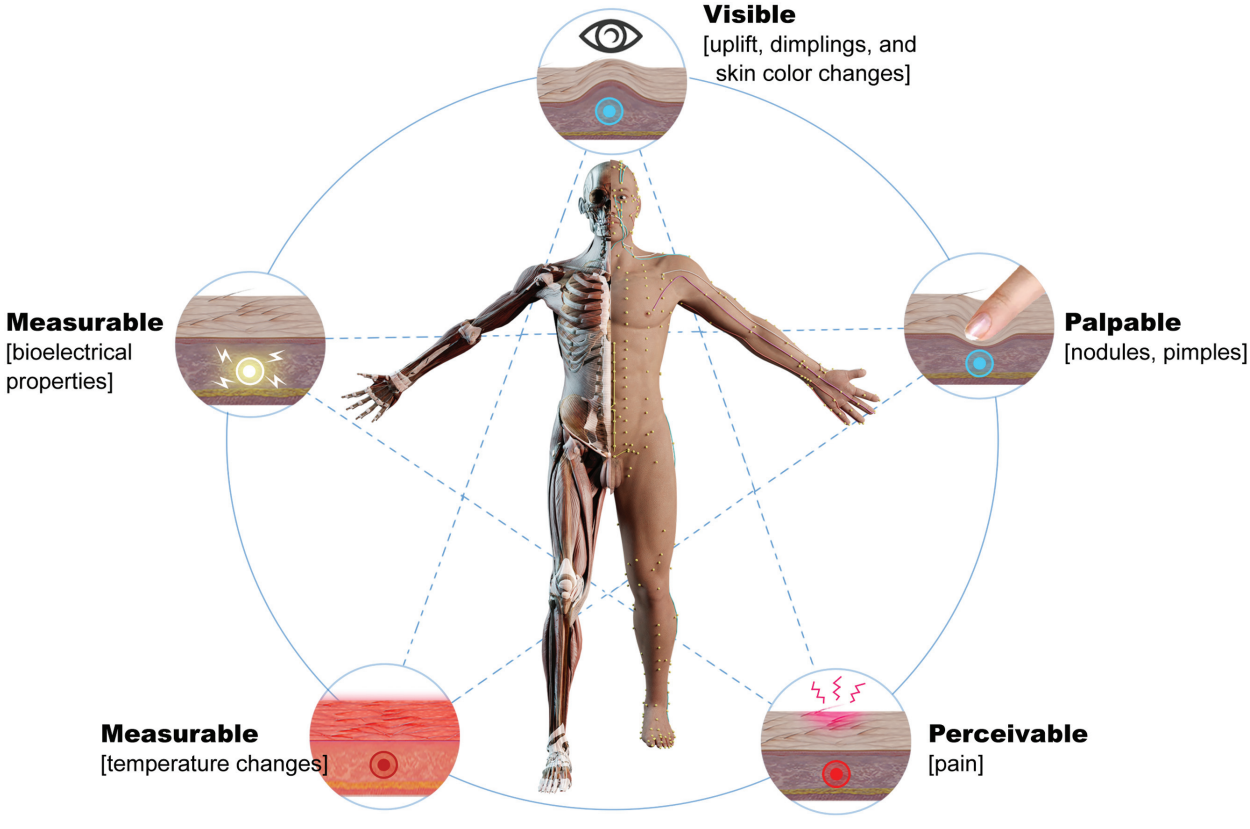

Figure 2. Pathophysiologic characteristics of SeAs.

From these results, we can infer that if the body is diseased, some SeAs will be sensitized and manifest pressure pain; otherwise, they will be identical to normal tissues.

Studies have shown that the incidence of pressure pain in SeAs is significantly higher during the menstrual period than the non-menstrual period in patients with primary dysmenorrhea[54]. Furthermore, during the menstrual period, the pain threshold for SeAs in patients is relatively lower than that for the same acupoints in healthy subjects. The mechanism underlying the decreased pain threshold in SeAs may be related to an increase in algogenic substances in the SeAs[15,55].

In summary of the normal conditions, TrPs will not be palpable, and SeAs will not manifest change in their pain threshold. If the body condition changes, as in sickness, the pain threshold decreases due to sensitization, and will slowly return to a healthy state after effective treatment[56-57].

3.3.1 Neuropathological mechanism

Studies have suggested a scientific explanation for the pathophysiology of TrPs[58–59]: the mechanism that causes the formation of TrPs is a central sensitization in the spinal cord. The chronic pain of many myofascial pain syndromes is associated with neuroplasticity and central sensitization; the latter refers to the increased sensitivity of nociceptor neurons in the central nervous system. This is affected by information from the body and is the result of changes caused by nerve damage. Research on the mechanism of acupoints is currently in the hypothetical stage and has not yet been fully confirmed. However, according to the hypothesis of acupoints sensitization, it is now generally believed that "acupoints sensitization is the external manifestation of central sensitization[15]."

One probable mechanism is that the nociceptive input from the viscera or the exterior through the dorsal root ganglion neurons activates the onward movement to the dorsal horn of the cells or backward to the periphery. The spinal cord dorsal horn impulse that is transmitted forward through the interneurons activates the other dorsal root ganglion cells. Then, the impulse outflows in a backward direction to the periphery through dorsal root reflexes. In addition, there is branching among the dorsal root ganglion cells. The viscera afferent impulse outflows backwardly to the periphery as an axonal reflex in the branches. The central sensitization mechanism of TrPs is proposed to be similar.

3.3.2 Biochemical mechanisms

Researchers have found that there are increased concentrations of bradykinin, calcitonin gene-related peptide (CGRP), P-substance (SP), tumor necrosis factor-α, interleukin-1β, serotonin (5-HT), and norepinephrine in TrPs[60–61]. However, non-TrPs do not possess these biochemical properties[60,62]. Studies have also found higher concentrations of 5-HT, histamine (HA), and SP in SeAs, as compared to non-SeAs[21,55]. These findings indicate that the material bases of TrPs are similar to those of SeAs. Inflammatory substances, such as SP and CGRP, cause hemangiectasis and plasmexhidrosis; SP further stimulates the aggregation and degranulation of mast cells, which releases algogenic substances such as HA and 5-HT and results in hyperalgesia in the local skin[15,55,63–66]. These substances might be the common biochemical bases that reduce the pain threshold of TrPs and SeAs, and their increases could show that there is a similar sensitized micro-physicochemical environment between TrPs and SeAs. That they have substance bases in common provides further evidence that TrPs are similar to SeAs.

3.4 Body surface temperature

Temperature is a vital sign of the human body. Studies have reported that the temperature of TrPs is significantly higher than that of non-TrPs. In the case of myofascial TrPs, these present as a hyperradiative surface of heat, with the propagation of the signal along with the referred pain site[67]. The temperature of SeAs will change while there are pathological changes in the body. Studies have found a significantly higher occurrence of temperature-sensitive acupoints when the body has a disease[68–70]. In addition, disease-related SeAs present significantly higher temperatures than non-acupoints. Ovechkin et al.[71–72] found an obvious difference in temperature between SeAs and the surrounding region. They also found that temperature can reflect the severity of a disease. The temperature detected with a thermal image detector has shown that, in visceral illnesses such as those in the heart, lung, and stomach, the temperature of the corresponding acupoints are abnormal; this indicates that temperature can mirror the physiological and pathological phenomena of organs after the acupoints related to the disease are sensitized[69,73–74].

The use of high-sensitivity temperature points achieves a better effect in the treatment[75]. Using an infrared thermal imager to observe temperature changes in the acupoint Hegu (LI 4) and non-acupoints after needling acupoint, researchers found that the temperature of each fingertip and metacarpal midpoint increased significantly; the temperature did not rise at non-acupoints[76]. From this, it can be inferred that the adjustment of local temperature in acupoints is superior to that in non-acupoints, which may be the reason why SeAs have an improved curative effect. According to TCM theory, diseases emerge from cold and heat syndromes. In the heat syndrome, the temperature increases; in the cold syndrome, it decreases[77]. Therefore, changes in acupoint temperature may be related to SeA performance; the same occurs with TrP temperature changes. However, further study is needed to document the regularity and characteristics of temperature changes between cold and heat.

Research has shown that a change in point temperature will return to normal if effective action is taken. Kruse and Christiansen[50] found that if TrPs are pressed, the temperature will drop by 0.6°C. While it is difficult to define the severity of myofascitis using the temperature from 15 minutes after pressing TrPs, thermography may be able to play an important role in the clinical differentiation of myofascitis. Similar temperature effects were found by Seixas et al.[78]. It was shown that there is an obvious temperature difference before and after needling SeAs, which can reduce the body temperature that increases after acupuncture[79–80]. In addition, acupuncturing SeAs can drop the temperature of SeAs by about 0.1°C to 1.1°C[74]. Studies suggest that the surface temperature changes in TrPs and SeAs may be associated with autonomic nerve and metabolic changes[81–83].

3.5 Bioelectrical properties

Researchers have found that the trigger-point skin resistance is reduced compared with the surrounding

tissues[49,84]. This decrease in skin resistance is related to activation of the sympathetic nervous system. Acupoints are reported to have the electrical characteristics of "low resistance, high capacitance."

Becker et al.[85] found that about half of the acupoints have measurable electrical properties, which confirms that the properties of acupoints can be quantified. However, the study did not state whether the included volunteers possessed the disease characteristics of the studied meridians; this makes the correspondence between the research results and traditional acupuncture points incomplete. The electrical properties of the acupoints might reflect the specificity of their physiological function and pathological changes in the body; the diagnostic coincidence rate does have clinical significance[86]. Some scholars used resistance measurements of heart-related acupoints in the diagnosis of heart disease. They found that these points had high diagnostic accuracy[87]. Based on these results, it has been suggested that bioelectrical impedance analysis could estimate the composition of acupuncture points according to the acupoint status. This finding could be used as a new acupoint evaluation method[88].

However, one study reported that there was low acupoint skin resistance in healthy people as well[89]. These results may indicate that the resistance measurement method is not yet developed enough for the resistance data to be reliable. Further scientific and technological developments should allow the establishment of standards for quantifying acupoint sensitization, measuring the resistance of SeAs more accurately, and evaluating the relationship between them.

The reason for the change in acupoint resistance might be related to the level of nitric oxide (NO) and expression of the nitric oxide synthase (NOS) protein in the skin tissue of acupoints. Exogenous NO and NOS inhibitors can promote the synthesis and release of norepinephrine in the skin tissue of acupoints, which increases sympathetic nerve activity and reduces the electrical resistance at acupoints[90]. Shah et al.[64] found that increasing sensitized substances at TrPs resulted in greater local blood flow and sweat secretion through stimulation of the autonomic nervous system. The increase in sweat content may also explain the changes in skin resistance.

4 Discussion

Peripheral stimulation therapy is receiving an increasing amount of attention due to the progress of the National Institutes of Health Common Fund's "Stimulating Peripheral Activity to Relieve Conditions (SPARC)" project. One key aspect for progress is the proper choice of the stimulus points, among which TrPs and SeAs undoubtedly have the most potential as personalized targets.

TrPs and SeAs have similar or even identical performance characteristics (Table 1). They also show an extremely high correlation in the clinical application; both can reflect clinical diseases. The states of TrPs are a characteristic manifestation of the myofascial syndrome[18] and reflect some visceral diseases[17]. The conditions of SeAs are associated with diseases of the meridians and organs. Both TrPs and SeAs can be used in clinical treatment and TrPs and SeAs whose location overlap may have similar therapeutic effects. The appropriate stimulation of TrPs and SeAs can produce characteristic responses, such as the twitch response and sensory conduction at the SeAs[91], which can maximize efficacy. The latest research[92] published in *Nature* provides a reliable neuroanatomical basis for the therapeutic effects of acupoints. The therapeutic effect of acupuncture should no longer be regarded as a placebo effect. Furthermore, a fundamental study[93] found that stimulating SeAs can lead to greater activation of central neurons (such as wide dynamic range neurons, dorsal column nuclei, the subnucleus reticularis dorsalis, and the thalamic ventroposterolateral nucleus). The mechanism of SeAs and TrPs activities may be the activation of a humoral endocrine: an immune response that results in an amplification cascade effect that can enhance clinical treatments.

We cannot deny that TrPs are acupuncture points just because the theoretical sources between TrPs and known acupoints differ. Eventually, the differences between them might not matter at a functional level. Likewise, we cannot assert that TrPs are SeAs merely because TrPs possess acupoint characteristics, because they might turn out to function differently in a clinical manner. Further research on acupoint characteristics and the standardization of acupoint sensitization will help quantify SeAs and provide an objective basis for distinguishing between TrPs and SeAs. This review hopes to provide a new understanding of the definition of acupoints, as well as to provide a reference for future clinical and mechanistic research into the nature of acupoints.

Conflict of interest statement

Fanrong Liang is an editorial board member of this journal. None of the other authors declare any conflicts of interest.

Funding

This study was financially supported by the National Natural Science Foundation of China (Nos. 81590951,

Table 1

The characteristics between TrPs and SeAs.

Sensitive indications	TrPs	SeAs
Morphological structure	The nodule	The nodule, pimple, uplift, dimpling, and skin color change, etc
Distributional ranges	↑	↑
Pain threshold	↓	↓
Local temperature	↑	↑
Resistance	↓	↓
Micro-physicochemical Environment	↑ (5-HT, SP, CGRP, Bk, TNF-α, IL-1β, noradrenaline); obvious phenomenon of MC degranulation	↑ (5-HT, SP, CGRP, TRPV-1, HA, bradykinin receptor); obvious phenomenon of MC degranulation

"↑": increasing; "↓": decreasing.

81973962, 82004486), the National Key Research and Development Project (No. 2019YFC1709701), the Key Research and Development Project of Science and Technology Department of Sichuan Province (Nos. 2020YFS0304, 2021YFS0087), and Innovation Team and Talents Cultivation Program of National Administration of Traditional Chinese Medicine. (No. ZYYCXTD-D-202003).

Author contributions

Fanrong Liang, Ling Zhao, and Mingsheng Sun conceived and designed this review; Mingsheng Sun and Mingxiao Yang drafted this article; Jing Rong, Xingsha Ma, Hui Zheng, and Dingjun Cai revised the manuscript. All the authors read and approved the final manuscript.

Ethical approval of studies and informed consent

Not applicable.

Acknowledgments

We would like to thank Smart Study Education and Technology Group (https://www.smartstudy.com/) for editing the English text of a draft of this manuscript.

References

[1] Fan AY, Xu J, Li YM. Evidence and expert opinions: Dry needling versus acupuncture (I) : The American Alliance for Professional Acupuncture Safety (AAPAS) White Paper 2016. *Chin J Integr Med* 2017;23(1):3–9.
[2] Fan AY, Xu J, Li YM. Evidence and expert opinions: dry needling versus acupuncture (II). *Chin J Integr Med* 2017;23(2):83–90.
[3] Fan AY, Xu J, Li YM. Evidence and expert opinions: dry needling versus acupuncture (III) – The American Alliance for Professional Acupuncture Safety (AAPAS) White Paper 2016. *Chin J Integr Med* 2017;23(3):163–165.
[4] Liu L, Skinner MA, Mcdonough SM, et al. Traditional Chinese medicine acupuncture and myofascial trigger needling: the same stimulation points? *Complement Ther Med* 2016;26:28.
[5] Peng ZF. Comparison between Western trigger point of acupuncture and traditional acupoints. *Zhongguo Zhen Jiu* 2008;28(5):349.
[6] Dorsher PT. Can classical acupuncture points and trigger points be compared in the treatment of pain disorders? Birch's analysis revisited. *J Altern Complement Med* 2008;14(4):353–359.
[7] Dorsher PT. On the probability of trigger point-acupuncture point correspondences: an evidence-based rebuttal of Stephen Birch's commentary. *J Altern Complement Med* 2008;14(10):1184–1185.
[8] Birch S. On the impossibility of trigger point-acupoint equivalence: a commentary on Peter Dorsher's analysis. *J Altern Complement Med* 2008;14(4):343.
[9] Birch S. Trigger point–acupuncture point correlations revisited. *J Altern Complement Med* 2003;9(1):91–103.
[10] Gibson RG, Gibson SL. Neural therapy in the treatment of multiple sclerosis. *J Altern Complement Med* 1999;5(6):543–552.
[11] Zhu H, Most H. Dry needling is one type of acupuncture. *Med Acupunct* 2016;28(4):184–193.
[12] Dorsher PT, Fleckenstein J. Trigger points and classical acupuncture points: part 1: qualitative and quantitative anatomic correspondences. *Dtsch Zeitschrift Akupunkt* 2008;51(3):15–24.
[13] Dorsher PT, Fleckenstein J. Trigger points and classical acupuncture points: part 2: clinical correspondences in treating pain and somatovisceral disorders. *Dtsch Zeitschrift Akupunkt* 2008;51(4):6–11.
[14] Simons DG, Travell JG, Simons LS. Myofascial pain and dysfunction: the trigger point manual. Volume 1. Upper half of body. Lippincott Williams & Wilkins. 1999;21:22.
[15] Zhu B. The plasticity of acupoint. *Zhongguo Zhen Jiu* 2015;35(11):1203.
[16] Stedman's medical dictionary for the health professions and nursing. Lippincott Williams & Wilkins, 2005.
[17] Gerwin RD. Myofascial and visceral pain syndromes: visceral-somatic pain representations. *J Musculoskelet Pain* 2002;10(1–2):165–175.
[18] Facco E, Ceccherelli F. Myofascial pain mimicking radicular syndromes. *Acta Neurochir Suppl* 2005;92:147.
[19] Liang F. Acupuncture-Moxibustion. 2006;Shanghai Science and Technology Publishing House,
[20] Qi X, Ji CF, Shi H, et al. Distribution of sensitized acupoints on patients with functional intestinal disorder. *World Chin Med* 2013;8(3):259–262.
[21] Zhu B. The sensitization phenomenon of acupoint and biological significances. *Zhongguo Zhen Jiu* 2019;39(2):115–121.
[22] Lin W, Liu X, Zhou Y, et al. Research on the surface temperature of related channel points in patients with knee osteoarthritis based on infrared imaging technology. *Modern Tradit Chin Med Mater Med* 2021;23(05):1484–1489.
[23] Dorsher PT. Myofascial meridians as anatomical evidence of acupuncture channels. *Med Accupunct* 2009;21(2):91–97.
[24] Melzack R, Stillwell DM, Fox EJ. Trigger points and acupuncture points for pain: correlations and implications. *Pain* 1977;3(1):3–23.
[25] Wang C, Ge HY, Ibarra JM, et al. Spatial pain propagation over time following painful glutamate activation of latent myofascial trigger points in humans. *J Pain* 2012;13(6):537–545.
[26] Defrin R, Ronat A, Ravid A, et al. Spatial summation of pressure pain: effect of body region. *Pain* 2003;106(3):471–480.
[27] Xu GX, Zhou YM, Sun MS, et al. Clinical observation on distribution characteristics and rules of pain sensitivity points on body surface in patients with knee osteoarthritis. *Zhongguo Zhen Jiu* 2020;40(11):1198–1201.
[28] Yu LL, Li L, Qin QG, et al. Colorectal nociceptive signal input facilitates impact of acupoint stimulation of "Zusanli" (ST 36) on electrical activities of wide dynamic range neurons in lumbar spinal cord in rats. *Acupunct Res* 2014;39:390–395.
[29] Rong P, Li X, Li L, et al. Mechanism of dorsal column nuclei in acupoint sensitization phenomena. *World Chin Med* 2013;(4):316–319.
[30] Gerwin R. Myofascial pain syndrome: here we are, where must we go? *J Musculoskelet Pain* 2010;18(4):329–347.
[31] Henderson JC. Myofascial pain and dysfunction: the trigger point manual. *J Can Chiropr Assoc* 1984;28(3):341.
[32] Zhou K, Ma Y, Brogan MS. Dry needling versus acupuncture: the ongoing debate. *Acupunct Med* 2015;33(6):485.
[33] Trigger T, Manual P. Myofascial pain and dysfunction, The trigger point manual, 2nd Edition. (2 Volumes). *Anesth Analg* 2001;13(1):69–70.
[34] Legge D. A history of dry needling. *J Musculoskelet Pain* 2014;22(3):301–307.
[35] Jing Y, Han Y, Qi-wei X, et al. Phenomenon and regularity of acupoints sensitization for knee osteoarthritis. *China J Tradit Chin Med Pharm* 2019;34(11):137–140.
[36] Hairong L, Jianbin Z, Xiaohui H. Clinical application of acupoints diagnostic method. *Jilin J Tradit Chin Med* 2014;(4):5.
[37] Takla MK, Razek NM, Kattabei O, et al. A comparison between different modes of real-time sonoelastography in visualizing myofascial trigger points in low back muscles. *J Man Manip Ther* 2016;24(5):253–263.
[38] Ballyns JJ, Turo D, Otto P, et al. Office-based elastographic technique for quantifying mechanical properties of skeletal muscle. *J Ultrasound Med* 2012;31(8):1209–1219.
[39] Sikdar S, Shah J, Gebreab T, et al. Novel applications of ultrasound technology to visualize and characterize myofascial trigger points and surrounding soft tissue. *Arch Phys Med Rehabil* 2009;90(11):1829–1838.
[40] Zhang WJ, Liu ZC, Gao Y, et al. Clinical efficacy on knee osteoarthritis treated with ashi points based on the evaluation of musculoskeletal ultrasound technology. *World J Integr Tradit West Med* 2014;9(8):834–836.
[41] Müller CE, Aranha MF, Gavião MB. Two-dimensional ultrasound and ultrasound elastography imaging of trigger points in women with myofascial pain syndrome treated by acupuncture and electroacupuncture: a double-blinded randomized controlled pilot study. *Ultrason Imaging* 2015;37(2):152–167.
[42] Hudspith MJ, Siddall PJ, Munglani R. Chapter 23 – Physiology of pain. *Foundations of Anesthesia* 2006;267–285.
[43] Li YQ, Rong PJ, Xu WD, et al. Conditioning stimulation induced change in receptive field of spinal neurons. *Chin J Neurosci* 1999;316–319.
[44] Cummings M, Baldry P. Regional myofascial pain: diagnosis and management. *Best Pract Res Clin Rheumatol* 2007;21(2):367.

[45] Delaney GA, Mckee AC. Inter- and intra-rater reliability of the pressure threshold meter in measurement of myofascial trigger point sensitivity. *Am J Phys Med Rehabil* 1993;72(3):136.
[46] Bendtsen L, Jensen R, Jensen NK, et al. Muscle palpation with controlled finger pressure: new equipment for the study of tender myofascial tissues. *Pain* 1994;59(2):235.
[47] Bendtsen L, Jensen R, Olesen J. Qualitatively altered nociception in chronic myofascial pain. *Pain* 1996;65(2–3):259–264.
[48] Zhang Y, Ge HY, Yue SW, et al. Attenuated skin blood flow response to nociceptive stimulation of latent myofascial trigger points. *Arch Phys Med Rehabil* 2009;90(2):325.
[49] Shultz SP, Driban JB, Swanik CB. The evaluation of electrodermal properties in the identification of myofascial trigger points. *Arch Phys Med Rehabil* 2007;88(6):780–784.
[50] Kruse RAJr, Christiansen JA. Thermographic imaging of myofascial trigger points: a follow-up study. *Arch Phys Med Rehabil* 1992;73 (9):819–823.
[51] Prushansky T, Handelzalts S, Pevzner E. Reproducibility of pressure pain threshold and visual analog scale findings in chronic whiplash patients. *Clin J Pain* 2007;23(4):339.
[52] Chae Y, Kim HY, Lee HJ, et al. The alteration of pain sensitivity at disease-specific acupuncture points in premenstrual syndrome. *J Physiol Sci* 2007;57(2):115–119.
[53] Qi XZ, Chen LZ, Zhang XN, et al. Distribution of algesia sensitized acupoints in the patients of intestinal cancer. *Zhongguo Zhen Jiu* 2017;37(9):963–966.
[54] Chen S, Miao Y, Nan Y, et al. The study of dynamic characteristic of acupoints based on the primary dysmenorrhea patients with the tenderness reflection on Diji (SP 8). *Evid Based Complement Alternat Med* 2015;2015:158012.
[55] He W, Wu M, Jing XH, et al. Entity of acupoint: kinetic changes of acupoints in histocytochemistry. *Zhongguo Zhen Jiu* 2015;35 (11):1181.
[56] Farasyn A, Meeusen R. Effect of roptrotherapy on pressure-pain thresholds in patients with subacute nonspecific low back pain. *J Musculoskelet Pain* 2007;15(1):41–53.
[57] Moraska AF, Schmiege SJ, Mann JD, et al. Responsiveness of myofascial trigger points to single and multiple trigger point release massages: a randomized, placebo controlled trial. *Am J Phys Med Rehabil* 2017;96(9):639.
[58] Hong CZ, Simons DG. Pathophysiologic and electrophysiologic mechanisms of myofascial trigger points. *Arch Phys Med Rehabil* 1998;79(7):863–872.
[59] Hong CZ. Pathophysiology of myofascial trigger point. *J Formos Med Assoc* 1996;95(2):93–104.
[60] Shah JP, Phillips TM, Danoff JV, et al. An in vivo microanalytical technique for measuring the local biochemical milieu of human skeletal muscle. *J Appl Physiol* 2005;99(5):1977–1984.
[61] McLennan H. The theoretical foundations of Chinese medicine by Manfred Porkert. *Pacific Affairs* 1978;47(4):533.
[62] Shah JP, Gilliams EA. Uncovering the biochemical milieu of myofascial trigger points using in vivo microdialysis: an application of muscle pain concepts to myofascial pain syndrome. *J Bodyw Mov Ther* 2008;12(4):371–384.
[63] De SR, Selvi E, Villanova M, et al. Image analysis quantification of substance P immunoreactivity in the trapezius muscle of patients with fibromyalgia and myofascial pain syndrome. *J Rheumatol* 2000;27(12):2906–2910.
[64] Shah JP, Danoff JV, Desai MJ, et al. Biochemicals associated with pain and inflammation are elevated in sites near to and remote from active myofascial trigger points. *Arch Phys Med Rehabil* 2008;89 (1):16.
[65] Müller W, Stratz T. Local treatment of tendinopathies and myofascial pain syndromes with the 5-HT3 receptor antagonist tropisetron. *Scand J Rheumatol Suppl* 2009;33 (sup119):44–48.
[66] Baldry PE, FRCP MB, John W, et al. Acupuncture, Trigger Points and Musculoskeletal Pain (Third Edition). Churchill Livingstone, 2005; 384.
[67] Rossi C, Sehnem E, Rempel C. A termografia infravermelha na avaliação dos pontos-gatilho miofasciais em patologias do ombro. *Conscientiae Saude* 2013;12(2):208–212.
[68] Li CR, Xun L, Bai ZH, et al. Characteristic research of three yin meridians of hand distributed in upper arms of pulmonary tuberculosis using infrared thermal imaging. *J Liaoning Univ Tradit Chin Med* 2013;15(2):99–101.
[69] Ovechkin AM. Application of infrared thermography in diagnostics of acute viral infections of respiratory system. *Med Thermogr* 2002;1(2):70–76.
[70] Chen RX, Kang MF, Chen MR. Return of Qibo: on hypothesis of sensitization state of acupoints. *Zhongguo Zhen Jiu* 2011;31 (2):134–138.
[71] Ovechkin A, Lee SM, Kim KS. Thermovisual evaluation of acupuncture points. *Acupunct Electrother Res* 2001;26(1–2):11.
[72] Ovechkin A, Kim KS, Lee JW, et al. Thermo-visual evaluation of the Yin-Tang acupuncture point for intracranial hypertension syndrome. *Am J Chin Med* 2003;31(3):455.
[73] Zhang YQ, Ding GH, Shen XY. Difference of the infrared spectra radiated from the acupoints between healthy volunteers and patients of coronary heart disease. *Zhongguo Zhen Jiu* 2004; (12):846–849.
[74] Shui YL, Institute QH, Pasadena. Infrared imaging system as a versatile diagnostic and auxiliary treatment tool in Chinese Medicine. 11th International Conference on Quantitative InfraRed Thermography.2012;10.21611/qirt.2012.273.
[75] Zhang D. A method of selecting acupoints for acupuncture treatment of peripheral facial paralysis by thermography. *Am J Chin Med* 2007;35(6):967.
[76] Agarwalkozlowski K, Lange AC, Beck H. Contact-free infrared thermography for assessing effects during acupuncture: a randomized, single-blinded, placebo-controlled crossover clinical trial. *Anesthesiology* 2009;111(3):632–639.
[77] Zheng X, Hua LU. Study of thermo metabolic features in infertility with Yang-deficiency. *Liaoning J Tradit Chin Med* 2014;41 (07):1412–1413.
[78] Seixas A, Soares M, Vardasca R, et al. Using thermal imaging to monitor the treatment of latent myofascial trigger points. *3th Quantitative InfraRed Thermography* 2016;10.21611/qirt.2016.118.
[79] Gu Z, Cheng W, Ping Y. Observation of temperature variations at acupoints before and after needling using infrared thermographic apparatus—a preliminary report. *Acupunct Res* 1989;138613528.
[80] Meng XW, Liu GW, Wang XY, et al. An infrared-thermal-image observation on the therapeutic effects of puncturing Si-Tian-acupoint in patients with cervicalspondylotic radiculopathy. *Shanghai J Acupunct Moxibust* 2003;(09):29–31.
[81] Bron C, Dommerholt JD. Etiology of myofascial trigger points. *Curr Pain Headache Rep* 2012;16(5):439–444.
[82] Moreira DVQ, Nohama P. Mapeamento térmico nos pontos de acupuntura. *Rev Univ Vale Do Rio Verde* 2016;14:1034–1043.
[83] Shultz S, Driban J, Swanik C. The evaluation of electrodermal properties in the identification of myofascial trigger points. *Arch Phys Med Rehabil* 2007;88(6):780–784.
[84] Chiou SY, Chao CK, Yang YW. Topography of low skin resistance points (LSRP) in rats. *Am J Chin Med* 1998;26(1):19.
[85] Becker RO, Reichmanis M, Marino AA, et al. Electrophysiological correlates of acupuncture points and meridians. *Psychoenerg Syst* 1976;(1):105–112.
[86] Zhu B, Chen G, Xu R. Electrical characteristics and specificities of auricular points. *Zhongguo Zhen Jiu* 2001;(12):27–30.
[87] Al-Kasasbeh R, Korenevskiy N, Ionescou F, et al. Prediction and prenosological diagnostics of heart diseases based on energy characteristics of acupuncture points and fuzzy logic. *Comput Methods Biomech Biomed Eng* 2012;15(7):681–689.
[88] Kim SB, Lee NR, Shin TM, et al. Development and evaluation of a multi-frequency bioelectrical impedance analysis analyzer for estimating acupoint composition. *J Acupunct Meridian Stud* 2014;7(1):33.
[89] Colbert AP, Larsen A, Chamberlin S, et al. A multichannel system for continuous measurements of skin resistance and capacitance at acupuncture points. *J Acupunct Meridian Stud* 2009;2(4):259.
[90] Liang Y, Ma SX, Chen JX. Effect of nitric oxide on noradrenergic function and skin electric resistance of acupoints and meridians. *Acupunct Res* 2008;33(3):213.
[91] Chen RX, Ming-Fei R, Chen MR. Return of Qibo: on hypothesis of sensitization state of acupoints. *Zhongguo Zhen Jiu* 2011;31 (2):134–138.
[92] Liu S, Wang Z, Su Y, et al. A neuroanatomical basis for electroacupuncture to drive the vagal-adrenal axis. *Nature* 2021;598(7882):641–645.
[93] Li L, Rong P, Luo M, et al. The central mechanisms underlying the phenomenon of acupoint sensitization evoked by visceral nociceptive afferent. *Zhongguo Zhen Jiu* 2015;35(11):1187–1191.

How to cite this article: Sun MS, Yang MX, Rong J, Ma XS, Zheng H, Cai DJ, Zhao L, Liang FR. Trigger points and sensitized acupoints: same book, different covers? Acupunct Herb Med. 2021;1(2):74–80. doi: 10.1097/HM9.0000000000000018