

Review

The Local Mechanism of Acupuncture

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acupuncture;
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twitches

Scientific development of acupuncture is described to increase its therapeutic efficacy and ultimate utilization. Acupuncture may have central, local and placebo effects. Little is known about the local effects of acupuncture specific to needle penetration and/or movement. Acupuncture points, muscle trigger points and motor end-plate zones are identical. Therefore, the benefit of acupuncture in musculoskeletal pain relief for which it is most commonly used, would not be limited to classical acupuncture points on the meridians.

Intramuscular movements of the needle causes insertional activity which can be recorded on electromyography (EMG). The insertional activity occurs from depolarization of innervated single or grouped muscle fiber discharges which are micro-twitches and this is the basis of pain relief with EMG and intramuscular stimulation methods. Occasionally, needle penetration or manipulation in classical or electrical acupuncture may also evoke small local twitches. These observations suggest that needle induced local muscle twitches mediate musculoskeletal pain relief in acupuncture. These micro-twitches are capable of producing micro stretch effects on the adjacent shortened muscle fibers undergoing varying stages of denervation. This reduces the mechanical traction effect produced by these shortened muscle fibers on pain sensitive structures including intramuscular nerves and blood vessels. This theory of stretching shortened muscle fibers to produce pain relief would be justified when even more significant musculoskeletal pain relief can be obtained through inducing larger force twitches.

Therefore, automated and electrical twitch-obtaining intramuscular stimulation methods were invented to elicit larger twitches. These methods allow the objective localization of the motor end-plate zones and allow recording of the number, frequency and force of the twitches. Therefore, by mechanism of action and as so cited therapeutic relief, the twitch may be the local key to pain relief, not just a diagnostic sign for the localization of myofascial trigger points. [*Chin Med J (Taipei) 2002;65:299-302*]

Presented here is an original model for scientific development of more effective therapy from traditional remedies utilizing acupuncture as an example. The increase in acupuncture's therapeutic efficacy will impact its ultimate utilization.

Acupuncture may have central, local and placebo

effects. The central effects of acupuncture is attributed to the release of endogenous opioids, neurotransmitters and neurohormones. But these neuroactive chemicals are also associated with painful stimuli, vigorous exercise and relaxation training and are therefore not specific to acupuncture. Information is

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sparse concerning the local mechanism of action of acupuncture specific to needle penetration and/or movement.

Classical acupuncture describes *De Qi* as a subjective sensation of numbness, pressure, heaviness, soreness or distention resulting from needle placement at tender acupuncture (*ah shi*) points.¹ As the same *De Qi*-like sensation may be elicited by needling myofascial trigger points (MTrPs) [localized, tender, hyper-irritable spots in muscle where local pressure elicits pain and also a local muscle contraction, i.e., twitch response],² possibly acupuncture points and MTrPs are identical.³ Therefore, the benefit of acupuncture in musculoskeletal pain relief for which it is most commonly used, would not be limited to classical acupuncture points.

Musculoskeletal pain relief can be obtained with procedures such as intramuscular stimulation (IMS)⁴ and electromyographic (EMG) examinations.^{5,6} Intramuscular movements of the needle causes insertional activity which can be recorded on EMG. The insertional activity occurs from depolarization of innervated single muscle fibers. When the nerve is hyper-excitabile, grouped single muscle fiber discharges occur which can also be recorded electromyographically as micro-twitches. The musculoskeletal pain relief with IMS and with EMG examination occurs from the elicitation of micro-twitches and when the needle is able to depolarize a larger intramuscular nerve, palpable or visible twitches can be observed. Occasionally, needle penetration or manipulation in classical or electrical acupuncture may also evoke small local twitches. These observations suggest that needle-induced local muscle twitches mediate musculoskeletal pain relief in acupuncture. These micro-twitches are capable of producing micro stretch effects on the adjacent shortened muscle fibers reducing the mechanical traction effect produced by these shortened fibers on pain sensitive structures including intramuscular nerves and blood vessels. This theory of stretching shortened muscle fibers to produce pain relief would be justified when even more significant musculoskeletal pain relief can be obtained through inducing larger force twitches.

Therefore, mechanisms for which larger force

twitches can be elicited were investigated. Presence of muscle macro-twitches allow the objective recording of the number, frequency and force of the twitches. This eliminates subjective confirmation of acupuncture point localization based upon patient *De Qi* impression or acupuncturist tactile sensation, such as “sticky points” and “needle grab”. An optimal treatment point twitch is obtained in 2 seconds using 2 Hz automated monopolar needle movement. Therefore, leaving needles stationary in tissue to obtain pain relief in classical acupuncture appears without physiologic basis or therapeutic benefit.

Muscle relaxation result from stretch effect to shortened muscle fibers leads to improved circulation. These mechanisms may contribute to twitch induced pain relief at the local level that in turn may have central effects on the pain gate⁷ in the spinal cord also. Therefore, by mechanism of action and associated therapeutic relief, the twitch may be the local key to pain relief, not just a diagnostic sign for the localization of MTrPs.⁸

Intramuscular oscillation of the needle is one technique to elicit many high force muscle twitches, but an acupuncture needle is unsuitable for this purpose since it lacks tensile strength. The acupuncture needle is unable to penetrate deep into muscle tissue and is therefore capable only of stimulating the superficial nerve muscle junction points or motor end-plate zones (MEPZs). A stronger, more durable, Teflon coated, monopolar EMG needle electrode that prevents tissue sticking to its shaft during oscillation, with a conical tip that causes little tissue trauma, is better suited for stimulating superficial and deep MEPZs.⁹ The most effective twitch points are along the length of intramuscular bands (especially at tender points along these bands), or along the length of the inter/intramuscular grooves. Therefore, classical acupuncture points or meridians in the trunk and limbs need not be studied or used for treatment, unless they can be identified as tender MEPZs. More important for identification of the treatment points is the clinician's ability to palpate for tender points along the intramuscular bands and nodes and to follow the intramuscular/intermuscular grooves that become delineated and visible when the twitches are elicited.

To facilitate twitch elicitation and to obtain larger force twitches, localized intramuscular electrical stimulation using electricity applied via the EMG machine to the Teflon coated monopolar EMG needle appears more efficient. Electrical twitch obtaining in intramuscular stimulation (ETOIMS) produces more rapid production of many larger force twitches from stimulation of more MEPZs per stimulus and produce better pain relieving results than on using mechanical stimulation only.¹⁰ More MEPZs deep within the muscle are stimulated to twitch due to stimulation of larger nerve terminals/trunks. ETOIMS elicited twitch force of ten is forceful enough to move a joint in the direction of action of the treated muscle, producing a greater stretch effect on the muscle.

Commonly, physical therapists use electrical stimulation to relax muscles but there is lack of precise delivery of electrical stimulus with transcutaneous nerve and muscle stimulation through electrical skin surface stimulation by faradic and interferential currents. In sufficient electrical current reaches the region of the MEPZs to elicit twitch responses equivalent to ETOIMS and the stimulation is diffuse and not focalized. Additionally, deep MEPZs are virtually unable to be stimulated. The use of electrical acupuncture or percutaneous electrical nerve stimulation (PENS)¹¹ has potential for local tissue injury because of application of an unknown quantity of electrical current from both the needle tip and stainless steel shaft. The prolonged treatment time ranging from 15 to 20 minutes may indeed facilitate occurrence of tissue injury. Although electrical acupuncture has been used with some success in pain relief possibly mediated through twitch generation, the use of a Teflon coated shaft with known exposed tip area of the monopolar EMG needle in ETOIMS permits better localization of the electrical stimulus. Also, the duration of the electrical stimulation with ETOIMS is only for 2 seconds and that is sufficient to fatigue immature or abnormal MEPZs related to degeneration or regeneration of nerves. The chances of tissue injury is further reduced when macro-twitch induced movement changes the muscle position of the needle and repetitive electrical stimulation of the same tissue is thus prevented even when the same skin insertion point is re-used.

Anyone who has experienced a muscle cramp has noted the relationship between relaxation of muscle spasm and immediate relief of muscle pain. Similar associations are noted with intramuscular twitch mediated immediate reduction of muscle pain. Therefore, enhanced twitch-obtaining methods were developed from acupuncture to improve therapeutic efficacy. The discussed local mechanism of acupuncture allows scientific speculation of the traditional concepts of *Yin*, *Yang* and *Qi* energies. *Yin* representing quiescence, coldness, downward direction, inward position, dimness, asthenia, inhibition, slowness, or organs inside the body may pertain to muscle (skelletal or smooth). *Yang* (representing movement, heat, upward direction, exterior position, bright, excited, rapid, non-substantial, trunk surface and the four extremities) may correspond to the nervous system (somatic and autonomic). All organs in the body are supplied with muscles, nerves and blood vessels and require neuromuscular or synaptic nerve transmission and blood circulation. *Qi* may therefore represent the energies required for or resulting from these functions. The balancing of excess and deficient *Yin* and *Yang* for maintenance of *Qi* may be understood as homeostasis.

The basis of many other applications of acupuncture will lie in understanding its interaction with the peripheral and autonomic nervous system and its interaction with the circulatory and the neuromuscular systems. The application of science to alternative medicine has potential for medical development. By understanding the local mechanism of acupuncture through ETOIMS, acupuncture use in the management of musculoskeletal pain will be accepted by scientists as medicine rather than as alternative medicine.

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