Spontaneous electrical activity at combined acupuncture and myofascial trigger point sites

Adam A Ward

Acupunct Med 1996 14: 75-79
doi: 10.1136/aim.14.2.75

Spontaneous Electrical Activity at Combined Acupuncture and Myofascial Trigger Point Sites

Adam A Ward

Summary

Small, localised areas of spontaneous electrical activity were found at combined acupuncture and myofascial trigger point sites, corresponding to Gall Bladder 21 in the Trapezius and Small Intestine 11 in the Infraspinatus, in patients with active myofascial neck and shoulder pain. The monopolar needle EMG techniques used to assess spontaneous electrical activity offer the possibility of providing an objective measure of both point activity and the effects of therapeutic intervention. Further studies are needed to examine not just the painful lesion itself, but its dynamic relationship with its corresponding spinal segment and associated higher centres. There are important similarities between acupuncture pain points and trigger points, and observations of both can be used profitably in further studies of myofascial pain and dysfunction.

Key words

Acupuncture point, Chronic pain, Dry needling, Electrical activity, EMG, Myofascial trigger point, Nociceptors, Spinal segment.

Introduction

Similarities between acupuncture and trigger points. It has long been recognised that traditional Chinese acupuncture points can occur at similar sites to myofascial trigger points. Melzack, Stillwell and Fox *(1)* found a 71% congruence when comparing site location and pain patterns. They went on to suggest that trigger points and acupuncture points for pain, though discovered independently and classified differently, represented similar phenomena and might be explained by the same neural mechanisms.

Clinical experience from other studies supports such correlations. Macdonald *(2)* looked at maps drawn by patients with myofascial pain, 85% traced lines connecting one area of pain to another, of which 96% bore a striking resemblance to Chinese acupuncture meridians.

FitzGerald *(3)*, a Cyriax trained medical manipulator, noted how trigger points disappeared after manipulation, often to reappear proximally at predictable sites. His myofascial trigger point pathways, based upon over 36 years of observations, are also reminiscent of acupuncture meridians *(Figure 1)*. His findings correlate with those of acupuncture points, which have been noted to become tender in an orderly progression and subsequently to disappear in reverse order as healing occurs *(4)*.

In addition, both acupuncture pain points and trigger points are often sited near motor points *(5-9)*. Motor points are associated with lowered electrical skin resistance which may, in part, be due to an anatomical hiatus around the passage of the motor nerve and its neurovascular bundle through the fascia and subcutaneous tissue.

This neurovascular bundle contains a variety of sensory afferents including Group Ia primary muscle spindle fibres, Group II secondary muscle spindle and A-β fibres, together with Group III, A-δ nociceptive and Group IV, C nociceptive fibres.

A functioning, afferent, nociceptive neural pathway is essential for acupuncture to work *(8)* and these fibres are well represented around motor points.

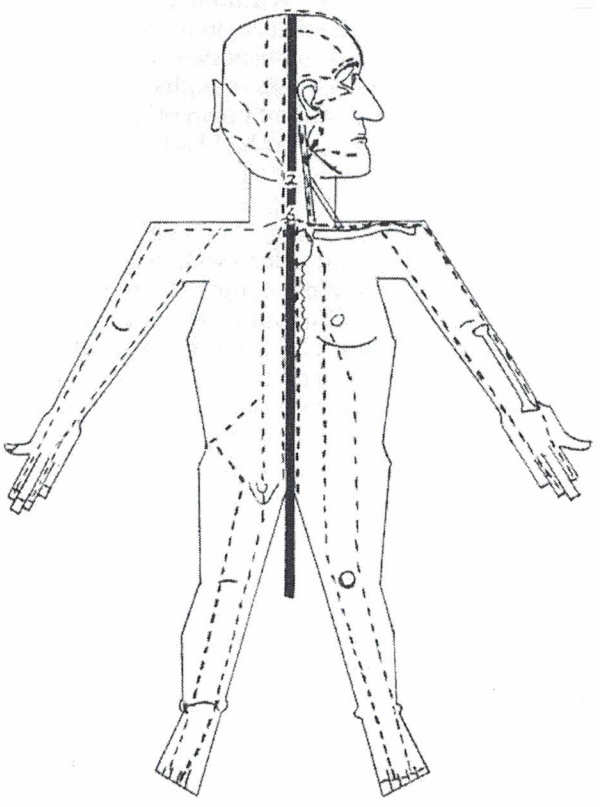

Figure 1. Myofascial trigger point pathways after FitzGerald (3).

Muscle needle grab and the heavy, sore, numb sensations associated with effective acupuncture needling known as *de qi* have been associated with Group II, III and IV muscle afferent activity. This is supported by the finding that injection of *procaine* into the muscle blocks acupuncture analgesia, whilst subcutaneous *procaine* superficial to the acupuncture point does not *(10)*. In addition, motor points also supply nerves to muscle spindles and motor end plates, both of which have been linked with the activity of trigger points *(9,11,22,27)*.

Traditional Chinese teaching states that acupuncture meridians are deeply imbedded in the muscles *(12)*. At designated points (acupuncture points) they connect with the surface of the skin where they can be needled and when active may be associated with pain and tenderness (*ah shi* points). In clinical practice, the depth of needling varies from a few millimetres to several centimetres, to involve skin and subcutaneous tissue through to muscles and deeper structures *(13)*. In a similar way, trigger points can be needled using superficial or deep insertion *(14)* and when active are painful and tender.

Electrical activity

Interest in the electrical measurement of acupuncture points has centred mainly on the skin surface *(15-18)* where they are associated with lowered electrical resistance (*cf* motor points). This forms the basis of most commercial acupuncture point locators. Other studies, which have also included measurement of direct current skin potentials, have attempted to correlate electrical activity with classical acupuncture theory and even form a basis for diagnosis *(18)*.

There have been a few Chinese EMG studies of acupuncture points, where muscle activity has been correlated with the sensation of de qi, propagated channel sensation and needle gripping *(18)*.

There have, however, been many EMG studies of trigger points and several have revealed small, discrete loci of spontaneous electrical activity. In 1940 Buchthal and Clemmesen identified spontaneous EMG activity which they considered arose in proprioceptive receptors *(19)*. In 1944 Elliott *(20)* used needle EMG techniques which showed prolonged motor unit activation in areas of focal muscle tenderness. In 1957 Travell *(21)* identified an increase in high frequency trigger point discharges, and since then there have been many such studies *(11)*.

In 1993 Hubbard and Berkoff, using monopolar needle EMG techniques, recorded very localised trigger point electrical activity *(11)*. They, together with McNulty and Gevirtz, went on to show increased trigger point EMG activity during experimentally induced psychological stress, which gave some support to the hypothesis of the role of sympathetically innervated intrafusal muscle spindle activity in the mediation of trigger point symptoms *(22)*. In 1994 Donaldson *et al. (23)* examined dynamic surface EMG changes in the sternomastoid and trapezius in patients with headaches and showed that muscles with trigger points responded initially with excess EMG activity, which faded to low levels with the onset of early fatigue.

Not all studies, however, have confirmed these findings. Durette *et al. (24)* could find no significant needle EMG changes in their series which included 21 patients with trigger points. By contrast, Simons, who in 1983 agreed *(25)* with the findings of Kraft *et al. (26)* that tense muscle fibres associated with myofascial trigger points did not show resting EMG activity, has since presented important evidence of such activity in a 1996 update *(27)*.

Method

Four combined points were chosen for this study, where acupuncture and trigger points are known to occur at the same sites and are associated with similar referral patterns. The chosen acupuncture points were *Gall Bladder 21 (Jianjing)* and *Small Intestine 11 (Tianzong)*, corresponding to trigger points in the Trapezius and the Infraspinatus *(Figures 2* and *3)*.

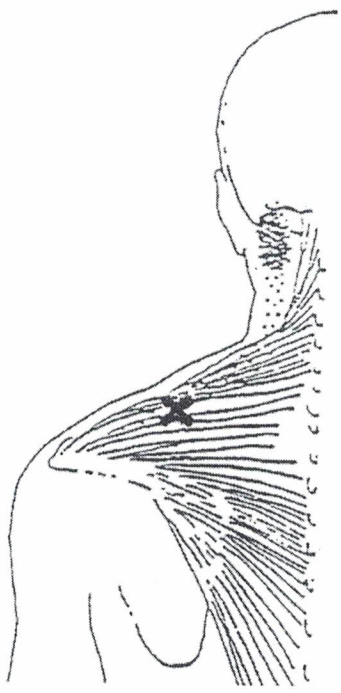

Figure 2. Combined acupuncture and trigger point site: Gall Bladder 21 (Jianjing) and myofascial TP in Trapezius.

The patients studied had active myofascial pain of a type and pattern associated with the chosen combined points and in the initial study 12 such points were examined.

Fine, monopolar (2 inch, 26 gauge) solid steel, disposable EMG needles coated almost to the tip with teflon insulation were inserted in the same way

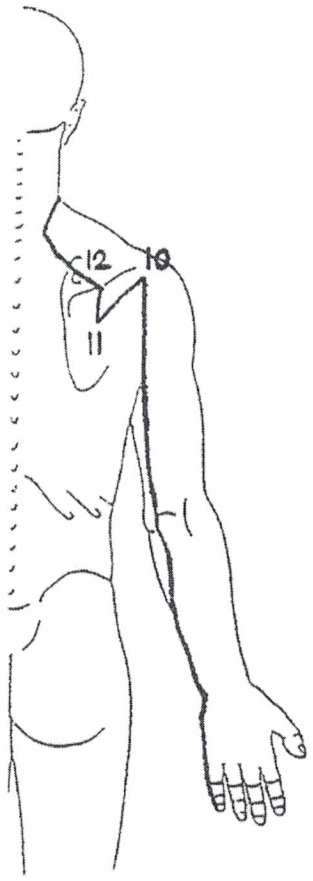

Figure 3. Combined acupuncture and trigger point site: Small Intestine 11 (Tianzing) and myofascial TP in Infraspinatus.

as an ordinary acupuncture needle. A standard EMG software programme was used and the tracings were calibrated to 100 milliseconds sweep speed per division with a gain of 100μV per division.

Two needles were used for the study of each combined point. The first needle was inserted intramuscularly 2 inches away from the acupuncture/trigger point to be studied and not in any other known point. It was inserted into the same muscle as the second needle and to an equivalent depth. The same non-tender sites were used for the placement of the first needle in all patients.

A common surface electrode was placed on the skin equidistant from the first intramuscular needle and the site for the second needle, which was not inserted until complete voluntary relaxation of the muscle was obtained, as demonstrated by the absence of motor activity from the first needle.

The second needle was then inserted at the site of the combined acupuncture/trigger point, which was located by anatomical reference and spot tenderness associated where possible with a jump sign, palpable band, referred pain/pain recognition and a twitch response. In all the points studied there was a clear correspondence between the location of the acupuncture and trigger points. The EMG needle was advanced by millimetre steps into the muscle once initial insertional activity had subsided.

Results

As the needle tip entered the muscle, electrical activity was monitored by speaker and oscilloscope for simultaneous auditory and visual analysis. The locus of activity, in all cases, was found to be in a discrete area of approximately one or two millimetres in diameter, within the main body of the muscle, below the surface skin location of the combined point.

Only one discrete locus of activity was found at each combined point. *Figure 4* shows needle EMG tracings for *Gall Bladder 21*. The lower tracing shows spontaneous electrical activity from the combined acupuncture/trigger point. Similar findings for *Small Intestine 11* are shown in *Figure 5*.

It was possible to pass the EMG needle through the active point into electrical silence on the other side and yet still withdraw the needle back into the point without destroying the EMG activity. This activity remained unchanged throughout the duration of the recording.

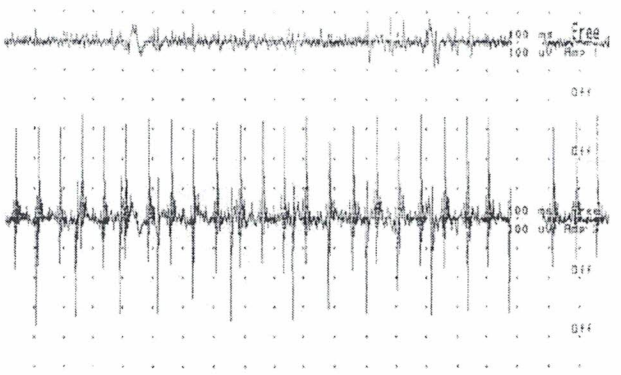

Figure 4. Spontaneous electrical activity (lower tracing) at combined acupuncture and trigger point site: Gall Bladder 21 and Trapezius myofascial trigger point. Upper tracing at an adjacent site also within the Trapezius.

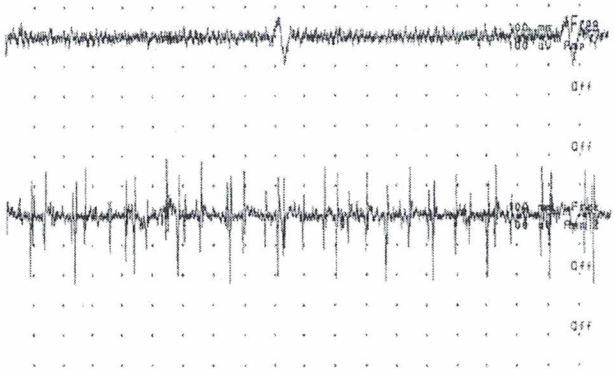

Figure 5 Spontaneous electrical activity (lower tracing) at combined acupuncture and trigger point site: Small Intestine 11 and Infraspinatus myofascial trigger point. Upper tracing at an adjacent site also within the Infraspinatus..

Discussion

Not all acupuncture points are trigger points and conversely not all trigger points are acupuncture points. Nevertheless, they have many similarities and there are places on the body where they clearly overlap. Both have confounded extensive searches for distinct morphologically unique anatomical structures which might allow their specific identification. Both are, however, associated with characteristics typical of discrete loci which, when activated, can produce similar spectrums of functional disturbance.

Current understanding of these points indicates that they represent small, circumscribed areas of primary or secondary dysfunction capable of evolving and changing over time and that they are, therefore, dynamic structures which can be measured by their functional activity. The nature of this dysfunction is not certain. There are three main hypotheses *(27)*.The *"Energy Crisis Theory"* postulates that release of ionic calcium, whether it be from the sarcoplasmic reticulum or from injured sarcolemma, causes sustained sarcomere shortening, increased metabolism and a compromised local circulation. This can then lead to an *"energy crisis"* and a self-perpetuating cycle. The *"Muscle Spindle Concept"* proposes that the source of localised, spontaneous electrical activity is related to dysfunctional intrafusal muscle spindles. The third, the *"Motor End Plate Hypothesis"*, puts the region of dysfunction at the extrafusal neuromuscular junction. In practice, some aspects of all three of these hypotheses could have a role to play in the maintenance of localised areas of dysfunction, which are likely to be a reflection of a wider disruption of reflex feedback loops between both extra and intra-fusal muscle fibres, together with an associated energy crisis.

Nociceptive afferent activity can itself be influenced by the noxious hurt that it signals. Plasticity within the system can lead to sensitisation to chronic pain both at the periphery and within the spinal cord and higher centres. Peripheral and central sensitisation is associated with an increase in sensitivity to nociceptive activity and includes the recruitment of *"sleeping nociceptors"* which would otherwise remain quiescent, all of which results in hyperalgesia.

Current ideas on the treatment of chronic pain include ways of rebalancing the nociceptive signalling system so as to return it to resting levels as an alternative to blocking nociceptive transmission with analgesics. The complex and subtle effects of acupuncture/dry needling through its selective and quantitative nociceptive stimulation, together with its potential for rebalancing hyperalgesic chronic pain states, places it firmly within the remit of anti-hyperalgesic pain research.

Next steps in the study of spontaneous electrical activity in myofascial pain will be to examine more fully, not just the painful lesion, but its dynamic relationship with its corresponding nerve roots, spinal segment(s) and higher centres. Such studies will provide opportunities for the investigation of the relationship between spontaneous electrical activity, therapeutic interventions such as acupuncture/dry needling and clinical symptoms.

Conclusion

Spontaneous EMG activity recorded with needles inserted at combined acupuncture and trigger points sites indicates the presence of very localised electrophysiological dysfunction.

The technique of recording this electrical activity using standard EMG equipment offers the possibility of providing objective evidence of point activity. This evidence can be used to assess the relationship of electrical point activity to clinical symptoms and the effects of a variety of therapeutic procedures including dry needling and classical acupuncture techniques.

In addition, further studies are needed to examine the broader aspects of localised dysfunction represented by spontaneous electrical activity, which may be a reflection of a wider imbalance of polysynaptic reflexes and their dynamic relationship with the corresponding nerve roots, spinal segment/s and higher centres.

There appear to be significant similarities between some acupuncture pain points and trigger points. Observations of both, each with their own body of literature, can be profitably applied to further studies.

Acknowledgements

I would like to thank Dr Nick Murray and Dr Geoff Sheean of The National Hospital for Neurology and Neurosurgery, Queen Square, London for their invaluable assistance with the EMG studies and the late Dr Richard FitzGerald for his diagram of myofascial trigger point pathways and for so freely sharing his ideas.

Adam A Ward
Consultant Musculoskeletal Physician
Royal London Homoeopathic Hospital
Great Ormond Street, London WC1N 3HR (UK)

References

1. Melzack R, Stillwell DM, Fox EJ. (1977) Trigger points and acupuncture points for pain: correlations and implications. *Pain. 3:* 3-23
2. Macdonald A (1982) *Acupuncture: from ancient art to modern medicine.* George Allen & Unwin, London
3. FitzGerald RTD (1991) Observations on trigger points, firbromyalgia, recurrent headache and the cervical syndrome. *Journal of Manual Medicine. 6:* 124-9 and personal communication
4. Dung HC (1984) Three principles of acupuncture points. *American Journal of Acupuncture. July-September:* 263-6. Cited in: Helms JM (1995) *Acupuncture energetics: a clinical approach for physicians.* Medical Acupuncture Publishers, Berkeley: *28*
5. Liu YK, Varela M, Oswald R (1975) The correspondence between some motor points and acupuncture loci. *American Journal of Chinese Medicine. 3:* 347-58
6. Gunn CC, Milbrandt WE, Little AS, Mason KE (1980) Dry needling of muscle motor points for chronic low back pain. *Spine. 5:* 279-91

7. Liao SJ (1975) Acupuncture points: coincidence with motor points of skeletal muscles. *Archives of Physical Medicine and Rehabilitation. 56:* 550
8. Baldry PE (1993) *Acupuncture, trigger points and musculoskeletal pain, 2nd edition.* Churchill Livingstone, Edinburgh
9. Travel JG, Simons DG (1983) *Myofascial pain & dysfunction. The trigger point manual. (Volume 1)* Williams & Wilkins, Baltimore: 21
10. Chiang CY et al. (1973) Peripheral afferent pathway for acupuncture analgesia. *Scientia Sinica. 16:* 210-17. Cited in: Helms JM (1995) *Acupuncture energetics: a clinical approach for physicians.* Medical Acupuncture Publishers, Berkeley: 33
11. Hubbard DR, Berkoff GM (1993) Myofascial trigger points show spontaneous needle EMG activity. *Spine. 18:* 1803-7
12. Veith I (trans) (1966) *Huang Di Nei Jing Su Wen (The Yellow Emperor's classic of internal medicine).* University of California Press, Berkeley
13. Chen E (1995) *Cross-sectional anatomy of acupoints.* Churchill Livingstone, Edinburgh
14. Baldry PE (1995) Superficial dry needling at myofascial trigger point sites. *Journal of Musculoskeletal Pain. 3:* 117-26
15. Hyvarinen J, Karlsson M (1977) Low-resistance skin points that may coincide with acupuncture loci. *Medical Biology. 55:* 88-94
16. Cho SH, Chun SI (1994) The basal electrical skin resistance of acupuncture points in normal subjects. *Ynsei Medical Journal. 35:* 464-74
17. Comunetti A, Laage S, Schiessl N, Kistler A (1995) A characterisation of human skin conductance at acupuncture points. *Experientia. 51:* 328-31
18. Bensoussan A (1991) *The vital meridian. A modern exploration of acupuncture.* Churchill Livingstone, Edinburgh: 61,63
19. Buchthal F, Clemmesen S (1940) On the differentiation of palpable muscle affections by electromyography. *Acta Med Scand. 150:* 48-66
20. Elliott FA (1944) Tender muscles in sciatica. *Lancet. 1:* 47-9
21. Travell JG (1957) Symposium on mechanism and management of pain syndromes. *Proceedings of Rudolf Virchow Medical Society. 16:* 128-36
22. McNulty WH, Gevirtz RN, Hubbard DR, Berkoff GM (1994) Needle electromyographic evaluation of trigger point response to a psychological stressor. *Psychophysiology. 31:* 313-6
23. Donaldson CCS, Skubick DL, Clasby RG, Cram JR (1994) The evaluation of trigger-point activity using dynamic EMG techniques. *American Journal of Pain Management. 4:* 118-22
24. Durette MR, Rodriquez AA, Agre JC, Silverman JL (1991) Needle electromyographic evaluation of patients with myofascial or fibromyalgic pain. *American Journal of Physical Medicine and Rehabilitation. 70:* 154-6
25. Travell JG, Simons DG (1983) Myofascial pain & dysfunction. *The trigger point manual (Volume 1).* Williams & Wilkins, Baltimore: 17
26. Kraft GH, Johnson EW, LaBan MM (1968) The fibrositis syndrome. *Archives of Physical Medicine and Rehabilitation. 49:* 155-62
27. Simons DG (1996) Clinical and etiological update of myofascial pain from trigger points. *Journal of Musculoskeletal Pain. 1:* 93-121