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**Review Article**

# TRIGGER POINTS AND ACUPUNCTURE POINTS FOR PAIN: CORRELATIONS AND IMPLICATIONS

RONALD MELZACK *, DOROTHY M. STILLWELL and ELISABETH J. FOX

*Department of Psychology, McGill University, and*
*Department of Medicine, Royal Victoria Hospital, Montreal, Que. (Canada)*

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## SUMMARY

Trigger points associated with myofascial and visceral pains often lie within the areas of referred pain but many are located at a distance from them. Furthermore, brief, intense stimulation of trigger points frequently produces prolonged relief of pain. These properties of trigger points — their widespread distribution and the pain relief produced by stimulating them — resemble those of acupuncture points for the relief of pain. The purpose of this study was to determine the correlation between trigger points and acupuncture points for pain on the basis of two criteria: spatial distribution and the associated pain pattern. A remarkably high degree (71%) of correspondence was found. This close correlation suggests that trigger points and acupuncture points for pain, though discovered independently and labeled differently, represent the same phenomenon and can be explained in terms of the same underlying neural mechanisms. The mechanisms that play a role in the genesis of trigger points and possible underlying neural processes are discussed.

## INTRODUCTION

It is well known that short-acting, local anesthetic blocks of trigger points often produce prolonged, sometimes permanent relief of some forms of myofascial or visceral pain [5,16,35]. Astonishingly, brief, intense stimulation of trigger points by dry needling [35], intense cold [35], injection of

* Reprint requests to Prof. R. Melzack, Department of Psychology, Stewart Biology Building, McGill University, Montreal, Que., Canada.

normal saline [33,34], or transcutaneous electrical stimulation [24] may also diminish or abolish these pains for days, weeks, and sometimes permanently. These effects of intense stimulation, which have been labeled as *hyperstimulation analgesia* [22], resemble the effects of acupunture — in which brief, intense pain is produced by rotating the needles manually or passing electrical currents through them — on arthritic, neuralgic, and other forms of chronic pain [5,12,20]. Well-controlled studies [3,10,12,24] show that these procedures produce significantly greater pain relief than placebo contributions. It is apparent, therefore, that intense stimulation of either trigger points or acupuncture points can produce prolonged relief of pain. Indeed, Fox and Melzack [9] have found that acupuncture and transcutaneous electrical stimulation are equally effective in relieving chronic low-back pain.

There is yet another similarity between trigger points and acupuncture points for pain: they often lie within the areas of referred pain, but many are located at a distance from them. Furthermore, some trigger points appear to coincide spatially with acupuncture points, and both kinds may be associated with the same pain patterns. The purpose of this study, therefore, was to determine the correlation between trigger points described by Travell and Rinzler [35], Kennard and Haugen [13], Sola and Kuitert [33], Sola and Williams [34] and acupuncture points for pain [11,18,19].

## DISTRIBUTION OF TRIGGER POINTS

Trigger points have long been used in Western medical practice for the diagnosis and treatment of pathological pain [15,35]. Application of pressure at a trigger point evokes pain at the point as well as referred pain in myofascial or visceral structures. Travell and Rinzler [35], in a classic study of myofascial pain, described a large number of spatial patterns of pain associated with trigger points (Figs. 1—4). Other points have been found by Sola and Kuitert [33] and Sola and Williams [34] (Fig. 5A), who examined myofascial pain associated with the shoulder, arm and neck. Additional points have been described by Bonica [5], Livingston [16], Kraus [15] and others.

Trigger points are also associated with visceral structures. McBurney's point is a well known site of tenderness in acute appendicitis, and gentle pressure at the point triggers local pain as well as distant diffuse abdominal pain [1]. Similarly, patients with cardiac disease frequently develop referred pain in the shoulder, chest, and arm [13,35]. Examination of cardiac patients by Kennard and Haugen [13] revealed a common pattern of trigger points (Fig. 5B) in the shoulder and chest. Pressure on the trigger points generally produces intense pain which sometimes persists for several hours. It is important to note that subjects who do not have heart disease have an almost identical distribution of trigger points [13]. The application of pressure at the trigger points in these subjects evokes pain which lasts for several minutes and may even increase in intensity for a few seconds after removal of the pressure.

## DISTRIBUTION OF ACUPUNCTURE POINTS

Perhaps the most baffling feature of acupuncture maps, on first encounter, is the profusion of points. Some degree of clarification is achieved if a particular book on acupuncture is examined *only* for points relevant to pain. We have done this for Kao and Kao's [11] book, *Acupuncture Therapeutics.* When the acupuncture points are organized on the basis of pain syndromes or discrete spatial locations of pain, the number of relevant acupuncture points is relatively small. An examination of Figs. 6 and 7, derived from Kao and Kao's [11] book, reveals that each major pain syndrome or painful region is associated with (a) acupuncture points that are at or near the actual site of pain, as well as (b) more distant points that are seemingly unrelated.

A similar analysis has been carried out with the maps and book prepared by Mann [18,19]. Although a multitude of points are designated specifically for the relief of particular pain syndromes, only a relatively small number of points is generally used in the actual day-to-day practice of acupuncture for the relief of pain (Figs. 8 and 9). As in Figs. 6 and 7, it is evident that there are points which lie within or near the painful area (Fig. 8), and others that lie at a distance from it (Fig. 9).

## CORRESPONDENCE BETWEEN ACUPUNCTURE POINTS AND TRIGGER POINTS

In order to determine the degree of correspondence between trigger points and acupuncture points, each trigger point on the maps of Travell and Rinzler [35], Sola and Kuitert [33], Sola and Williams [34] and Kennard and Haugen [13] (Figs. 1—5) was numbered and acupuncture maps were examined to see whether there was a nearby acupuncture point. Because Kao and Kao [11] used only selected points for their exposition of acupuncture, the more complete maps prepared by Mann [18] were used. Due to obvious differences in drawings, or even anatomical variation from person to person, the proximity of the points to particular muscle groups or other anatomical landmarks was sought. A difference of 3 cm between the two sites seemed to be a reasonable allowance for variation based on drawings or actual anatomical variability. If the points showed good correspondence (within the 3 cm criterion), the site was labeled "plus" (+). Acupuncture points outside the 3 cm criterion were labeled "minus" (—). The next step was to find the clinical syndromes, listed in Mann's [19] and Kao and Kao's [11] books, associated with the acupuncture points. If the clinical syndrome corresponded reasonably to that associated with the trigger point, a "plus" (+) was recorded. Lack of correspondence was labeled "minus" (—).

The results of this analysis (Table I), using Travell and Rinzler's points, indicate that every trigger point has a corresponding acupuncture point. Furthermore, there is a close correspondence (64%) between the pain syndromes associated with the two kinds of points. A similar procedure was carried out using the trigger points described by Sola and his colleagues, and by Kennard and Haugen (Table II). The degree of correspondence, in terms

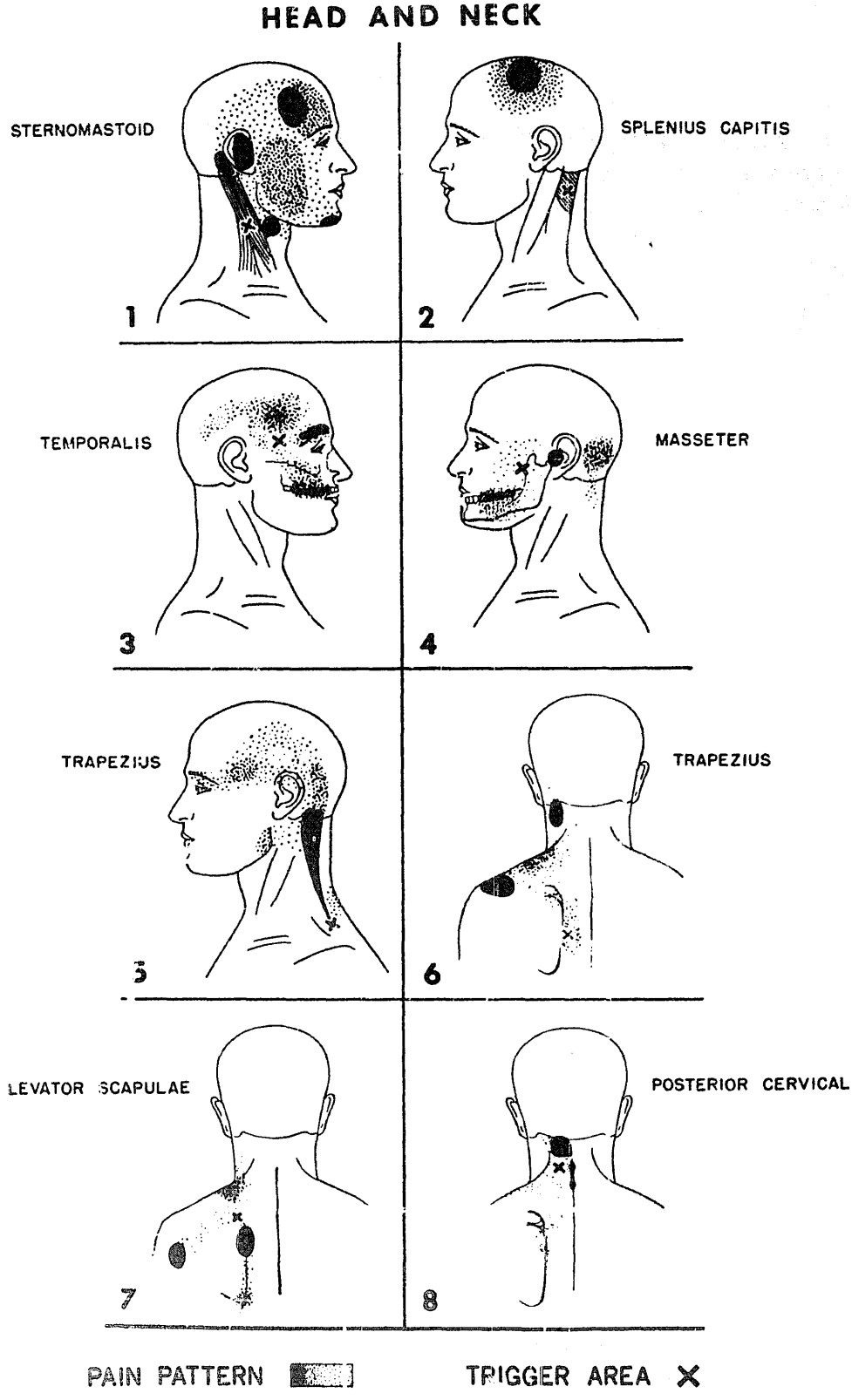


Fig. 1. Trigger points associated with myofascial pain syndromes of the head and neck. Reprinted from Travell and Rinzler [35]. Each trigger point is numbered and the major nerve innervation is described in Table I.

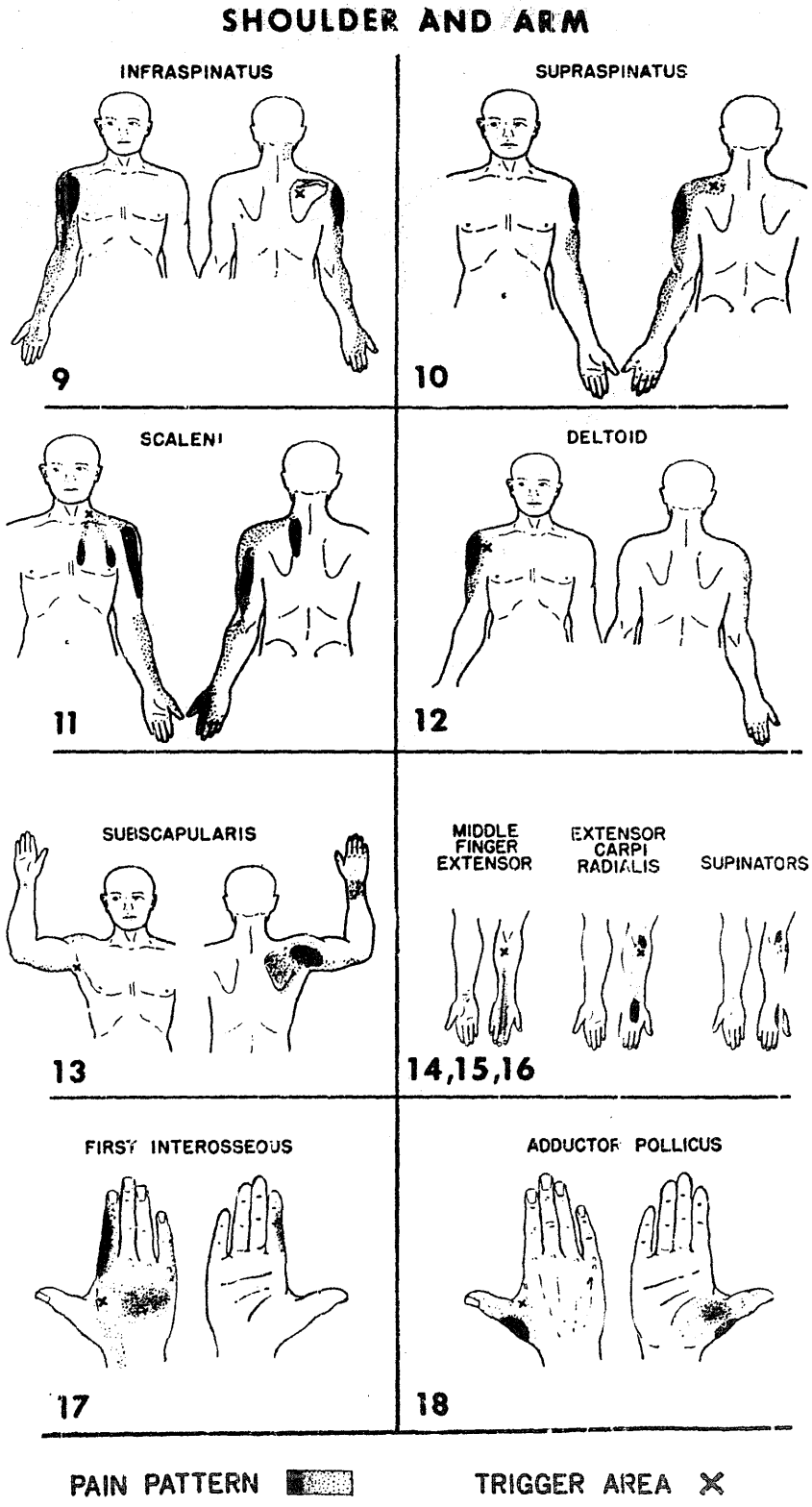


Fig. 2. Trigger points associated with myofascial pain syndromes of the shoulder and arm. Reprinted from Travell and Rinzler [35]. Each trigger point is numbered and the major nerve innervation is described in Table I.

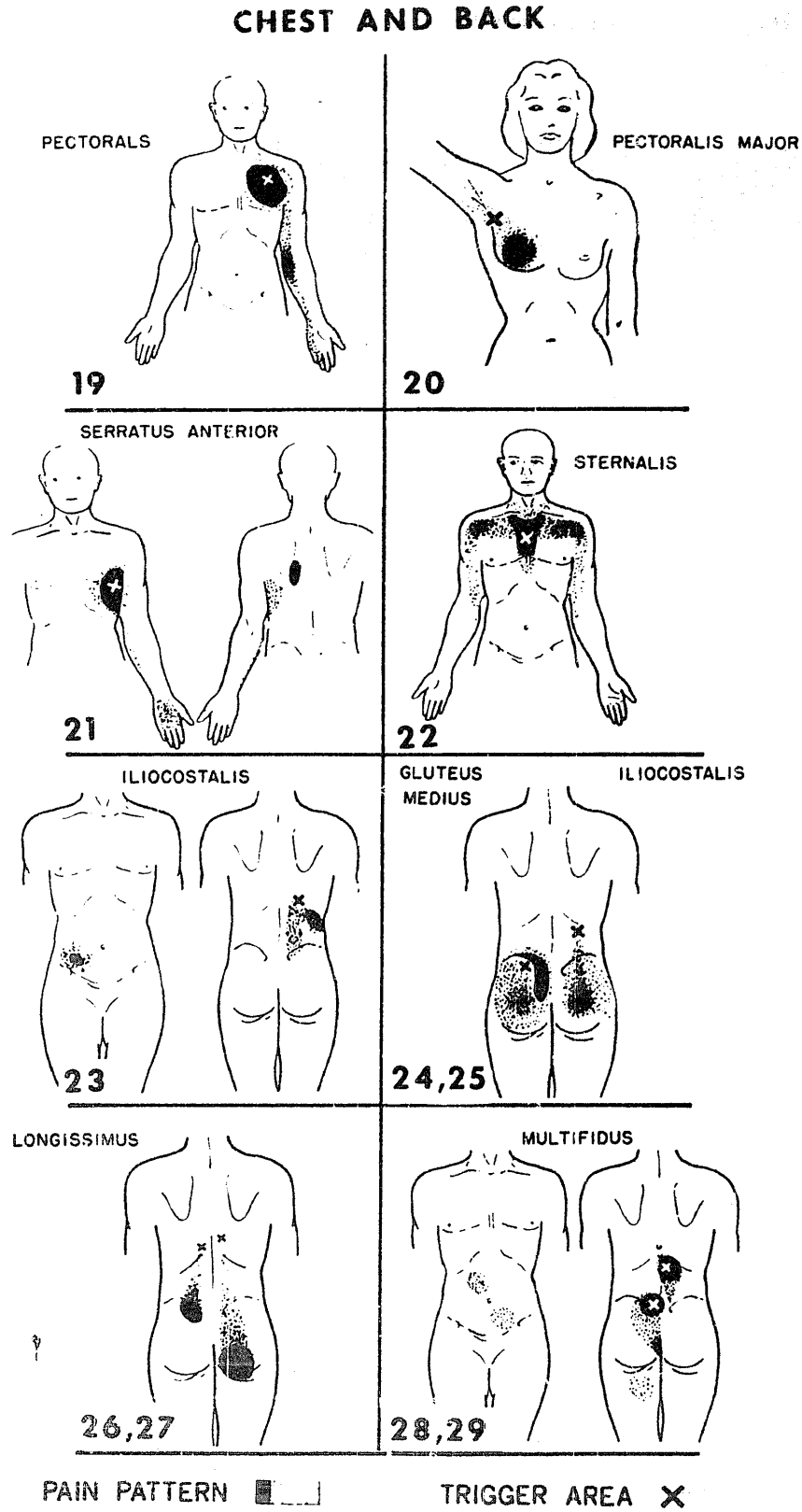


Fig. 3. Trigger points associated with myofascial pain syndromes of the chest and back. Reprinted from Travell and Rinzler [35]. Each trigger point is numbered and the major nerve innervation is described in Table I.

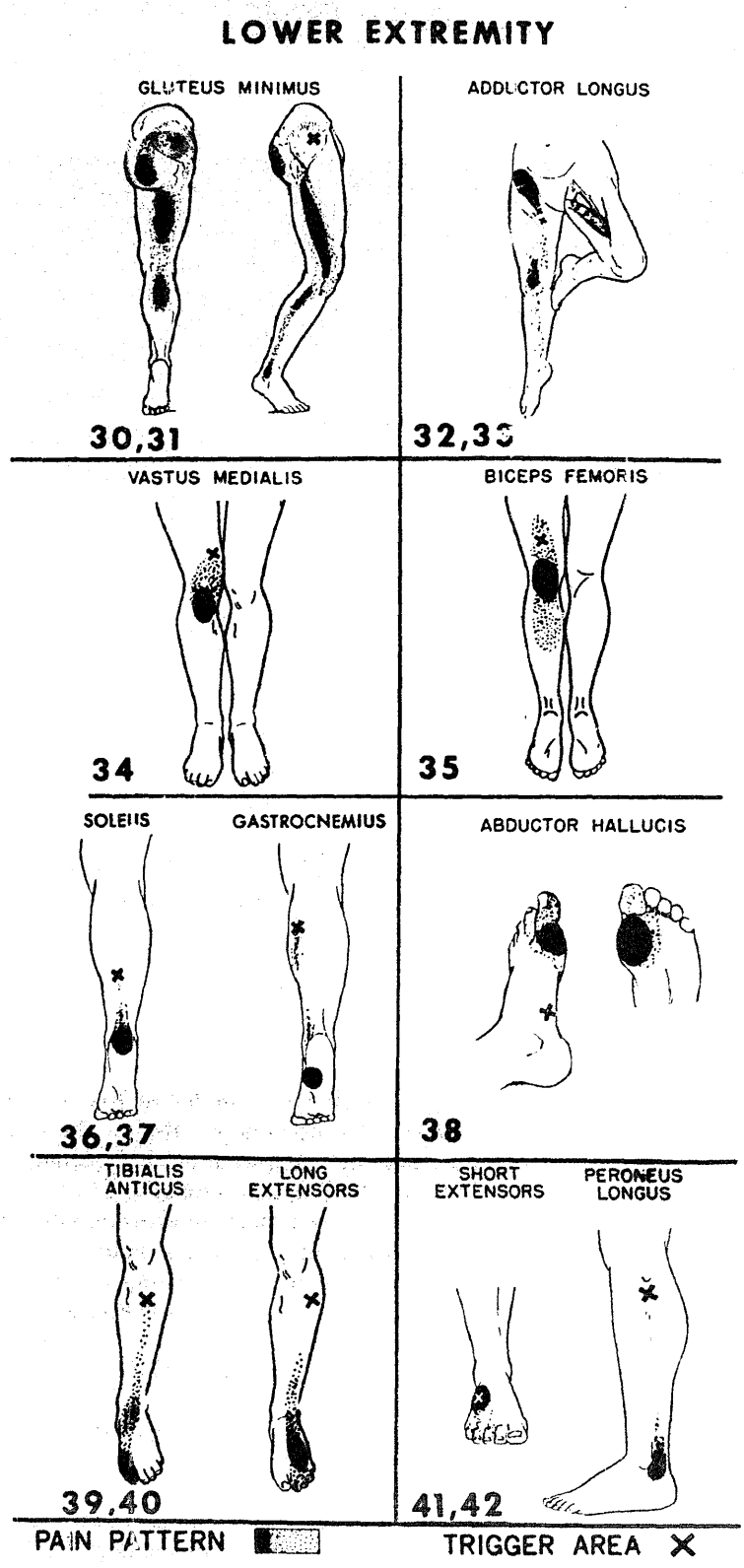


Fig. 4. Trigger points associated with myofascial pain syndromes of the lower extremity. Reprinted from Travell and Rinzler [35]. Each trigger point is numbered and the major nerve innervation is described in Table I.

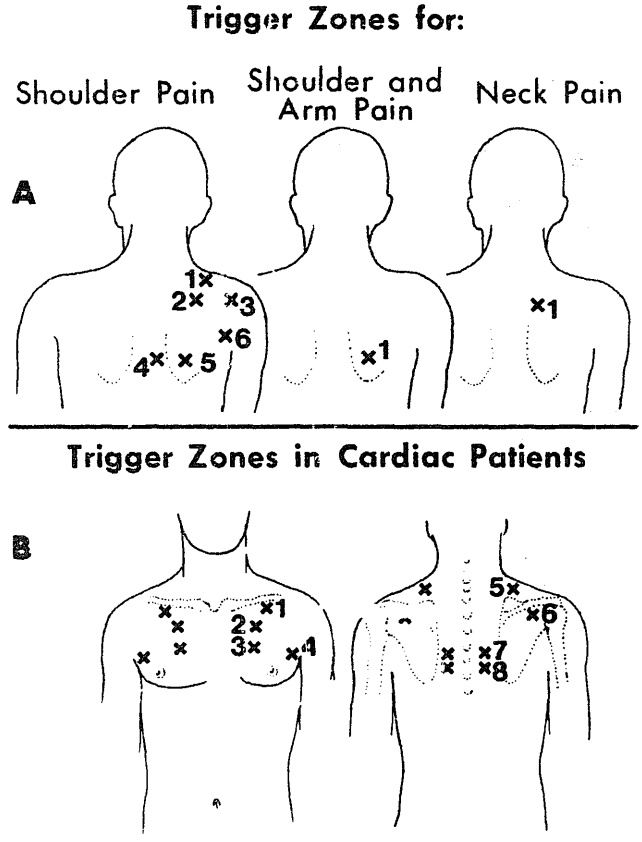


Fig. 5. Trigger points associated with (A) myofascial pain syndromes and (B) cardiac pain syndromes. The points in A are derived from Sola and Kuitert [33] and Sola and Williams [34]. The points in B are reprinted from Kennard and Haugen [13]. Each trigger point is numbered and the major nerve and muscle innervation is described in Table II.

TABLE I

Left: the number of the trigger points described by Travell and Rinzler in Fig. 1, the nerve innervation of the points, and the associated clinical syndrome(s). Right: the acupuncture point that coincides with the trigger point and the associated clinical pain syndrome(s) designated for the acupuncture point by Mann [19] and Kao and Kao [11]. The plus signs (++) indicating correspondence are shown under the Clinical Syndrome column at the right. The first plus sign indicates coincident or adjacent trigger and acupuncture points; the second indicates correspondence of clinical syndromes. A minus ( — ) sign denotes lack of correspondence. Abbreviations of the acupuncture points: see Fig. 6.

| Point no. | Trigger points | | Acupuncture points | |
|---|---|---|---|---|
| | Nerve innervation of trigger point | Clinical syndrome | Nearest acup. pnt. | Clinical syndrome |
| 1. | Accessory N. (XI) | Torticollis; myalgia of neck muscles; head and facial pains. | Li18 | Orbital neuralgia; hip pain. (++) |
| 2. | Dorsal Brs. C2—8 | Cervical disc disease; degenerative arthritis of cervical spine; headaches. | T16 | Headache; eye pain; shoulder, back and arm pain; stiff neck. (++) |

TABLE I (continued)

| Point no. | Trigger points | | Acupuncture points | |
|---|---|---|---|---|
| | Nerve innervation of trigger point | Clinical syndrome | Nearest acup. pnt. | Clinical syndrome |
| 3. | Trigeminal N. (V, Br. 3) | Migraine; myalgia. | XH3 | Headache; trigeminal neuralgia; toothache; eye pain (++) |
| 4. | Trigeminal N. (V, Br. 3) | Facial myalgia; toothache; headache; temporo-mandibular joint pain. | S7 | Facial neuralgia or spasm; headache; orbital neuralgia; eye pain. (++) |
| 5. | Accessory N. (XI) and branches of C3—4 | Shoulder, arm and neck pain; headache; stiff neck. | G21 | Stiff neck; shoulder and back pain; rheumatism; arm pain. (++) |
| 6. | Accessory N. (XI) and branches of C3—4 | Shoulder, arm and neck pain; headache; intrascapular pain. | B37 | Acute pain of shoulders. (++) |
| 7. | C3—5 | Myalgia in shoulder region. | Si14 | Muscular pain; neuralgia and spasm of shoulder and arm; spasm of neck muscles. (++) |
| 8. | C1—T1 | Degenerative diseases of cervical spine. | B10 | Brachial neuralgia; neck spasm; torticollis; writer's cramp. (++) |
| 9. | Suprascapular N. | Musculoskeletal diseases of the shoulder. | Si13 | Neuralgia and numbness of the shoulder and arm. (++) |
| 10. | Suprascapular N. | Musculoskeletal diseases of shoulder. | T15 | Pain of shoulder; back, arm, elbow, neck, clavicle; stiff neck. (++) |
| 11. | C4—8 (via cervical plexus) | Pain in neck and shoulder. | Li17 | Throat pain. (+—) |
| 12. | C5—6 (via brachial plexus); Axillary N. | Shoulder pain. | L2 | Neuralgia of shoulder; chest pain. (++) |
| 13. | Subscapular N. (C5—6 via brachial plexus) | Musculoskeletal diseases of shoulder. | H1 | Pain in chest and ribs; cardiac pain. (+—) |
| 14. | Radial N. | Extensor tendonitis of forearm; tennis elbow pain. | T9 | Pain in forearm and elbow joint; toothache. (++) |
| 15. | Radial N. | Extensor tendonitis of forearm; tennis elbow pain. | T9 | Pain in forearm and elbow joint; toothache. (++) |
| 16. | Radial N. | Extensor tendonitis of forearm; tennis elbow pain. | Li11 | Brachial or intercostal neuralgia; torticollis; elbow pains; pain in front of ear. (++) |

TABLE I (continued)

| Point no. | Trigger points | | Acupuncture points | |
|---|---|---|---|---|
| | Nerve innervation of trigger point | Clinical syndrome | Nearest acup. pnt. | Clinical syndrome |
| 17. | Ulnar N. (C8, via brachial plexus) | Tendinous strain in hand. | Li4 | Headache; migraine; neuralgia of scapula, back and renal areas; toothache; sore throat (+—) |
| 18. | Ulnar N. (C8, via brachial plexus) | Sprain of thumb. | Li4 | Headache; migraine; neuralgia of scapula, back and renal areas; toothache; sore throat. (+—) |
| 19. | Anterior thoracic N. (C5—T1, via brachial plexus) | Sternoclavicular arthritis. | S15 | Chest, ribs and limbs "heavy"; intercostal neuralgia. (++) |
| 20. | Anterior thoracic N. (C5—6, via brachial plexus) | Strain of pectoralis major. | Sp19 | Chest, ribs and limbs "heavy"; difficulty in lying down or turning. (++) |
| 21. | Long thoracic N. (C5—7, via brachial plexus) | Costal vertebral sprain; scapular fractures. | Sp17 | Chest, ribs and limbs "heavy"; diaphragmatic pain. (++) |
| 22. | C3—4 (?) | Chest pain; shoulder and arm pain. | Cv19 | Chest and breast pain; cardiac pain. (++) |
| 23. | L1 | Low back pain; myalgia of the long extensors of the back. | B44 | Rheumatism; intercostal neuralgia; abdominal discomfort. (+—) |
| 24. | Superior gluteal N. (L4—S1) | Lumbosacral strain. | B48 | Pain and stiffness in back and renal area; pain in lower abdomen. (++) |
| 25. | L1 | Low back pain; myalgia of long extensors of back. | B47 | Pain and stiffness of back. (++) |
| 26. | T8—T9 (dorsal brs.) | Low back pain; myalgia of long extensors of back. | B19 | Pain in lower ribs; eye pain. (+—) |
| 27. | T8—T9 (dorsal brs.) | Dorso-lumbar pain. | B18 | Intercostal neuralgia; eye pain. (+—) |
| 28. | C3—5 (dorsal brs.) | Myalgia of long extensors of back; paraumbilical pain. | B25 | Lumbar muscle spasm; pain around umbilicus; intestinal pain. (++) |
| 29. | C3—5 (dorsal brs.) | Myalgia of long extensors of back; paraumbilical pain. | B22 | Stiff vertebral column; tightening in back and shoulder; pain in loins. (++) |

TABLE I (continued)

| Point no. | Trigger points | | Acupuncture points | |
|---|---|---|---|---|
| | Nerve innervation of trigger point | Clinical syndrome | Nearest acup. pnt. | Clinical syndrome |
| 30. | Superior gluteal N. (L4—S1 via lumbosacral plexus). | Diseases of the hip joint; degenerative conditions of lumbar spine. | B49 | Lumbar and sacral pain; sciatica. (++) |
| 31. | Superior gluteal N. (L4—S1 via lumbosacral plexus). | Diseases of the hip joint; degenerative conditions of lumbar spine. | G30 | Pain in buttocks; sciatica; pain in loins, spine and thighs; rheumatism; pain in knee, pain in hip joint. (++) |
| 32. | Obdurator N. (L2—3, via lumbosacral plexus). | Strain of adductor muscles; degenerative diseases of the hip. | Liv11 | No pain syndromes. (+—) |
| 33. | Obdurator N. (L2—3, via lumbosacral plexus). | Strain of adductor muscles; degenerative diseases of the hip. | Liv10 | No pain syndromes. (+—) |
| 34. | Femoral N. (L2—4 via lumbosacral plexus) | Diseases of the knee joint; injury to quadriceps. | Sp10 | Pain along thigh. (++) |
| 35. | Tibial N. (L5—S2 via lumbosacral plexus) | Diseases of the knee joint; myalgia of the posterior thigh. | B51 | Pain in back and loin; sciatica. (+—) |
| 36. | Tibial N. (L5—S2 via lumbosacral plexus) | Tendon and muscle strains of the lower leg; periostitis of the calcaneus. | K7 | Pain in loins and back. (+—) |
| 37. | Tibial N. (S1—2, via lumbosacral plexus) | Tendon and muscle strains of the lower leg; periostitis of calcaneus. | K10 | Knee and thigh pain; genital pain during micturition; abdominal pain. (+—) |
| 38. | Tibial N. (S1—2, via lumbosacral plexus) | Disease of metatarsophalangeal joint of the big toe. | K2 | Chest pain; sharp stomach pain; leg and foot pain. (++) |
| 39. | Anterior tibial N. (L4—5, via lumbosacral plexus) | Strain of dorsiflexors of foot; ankle sprain. | S36 | Weak limbs; abdominal pain. (+—) |
| 40. | Common peroneal N. (L4—S1, via lumbosacral plexus) | Strain of toe extensors. | S37 | Arthritis of knee; pain on dorsiflexion of foot. (+—) |
| 41. | Common peroneal N. (L4—S1, via lumbosacral plexus) | Foot strain. | G40 | Pain in heels; pain in lower limbs; pain in chest and ribs; pain in buttocks, pain in lower abdomen; sciatica; muscular spasms. (++) |
| 42. | Common peroneal N. (L4—S1, via lumbosacral plexus) | Strain of foot evertors; ankle sprain. | G34 | Knee pain; pain in ribs; lumbago; sciatica. (+—) |

TABLE II

Left: the number of the trigger points described by Sola, Kuitert and Williams (A) and by Kennard and Haugen (B) in Fig. 2, the muscle (M) and nerve (N) innervation of the points, and the associated clinical syndrome(s). Right: the acupuncture point that coincides with the trigger point and the associated clinical pain syndrome(s) designated for the acupuncture point by Mann [19] and Kao and Kao [11]. The plus signs (++) indicating correspondence are shown under the Clinical Syndrome column at the right. The first plus sign indicates coincident or adjacent trigger and acupuncture points; the second indicates correspondence of clinical syndromes. A minus ( — ) sign denotes lack of correspondence. Abbreviations of the acupuncture points: see Fig. 6.

| Point no. | Trigger points | | Acupuncture points | |
|---|---|---|---|---|
| | Muscle and nerve innervation of trigger point | Clinical syndrome | Nearest acup. point | Clinical syndrome |
| A1 | M: Upper trapezius<br>N: Spinal accessory (XI) and brs. from C3—4 | Shoulder pain | G21 | Shoulder, back, and arm pain; rheumatism; stiff neck. (++) |
| A2 | M: Levator scapula<br>N: C3—4 and dorsal scapular | Neck pain shoulder pain | Si14 | Spasm and muscle pain of neck; neuralgia of shoulder and arm. (++) |
| A3 | M: Supraspinatus<br>N: Suprascapular | Shoulder pain | Si10 | Muscle pain; arthritis or swelling of shoulder and scapular area. (++) |
| A4 | M: Rhomboid major<br>N: Dorsal scapular | Shoulder pain | B40 | Brachial and intercostal neuralgia; spasm of back (++) |
| A5 | M: Infraspinatus<br>N: Suprascapular | Shoulder pain shoulder and arm pain | Si11 | Neuralgia in scapula or forearm. (++) |
| A6 | M: Teres minor<br>N: Axillary | Shoulder pain | Si9 | Arthritis and pain of upper limb and scapula. (++) |
| B1 | M: Pectoralis major (clavicular head)<br>N: Lateral pectoral (C5—7) | Cardiac syndromes | S13 | Chest, ribs, limbs "heavy"; spasm of diaphragm. (++) |
| B2 | M: Pectoralis major (sternal head)<br>N: Medial pectoral (C8—T1) | Cardiac syndromes | K24 | Pain in chest and diaphragm; effort angina syndrome; neuralgia of forearm. (++) |
| B3 | M: Pectoralis major (sternal head)<br>N: Medial pectoral (C8—T1) | Cardiac syndromes | K23 | Angina pectoris. (++) |
| B4 | M: Pectoralis major (both heads)<br>N: Pectoral nerves (C5—T1) | Cardiac syndromes | G22 | Intercostal neuralgia. (+—) |
| B5 | M: Trapezius<br>N: Accessory (cranial XI) | Cardiac syndromes | T15 (G21) | Shoulder, back and arm pain; rheumatism; stiff neck. (++) |

(Table II continued)

| Point no. | Trigger points | | Acupuncture points | |
|---|---|---|---|---|
| | Muscle and nerve innervation of trigger point | Clinical syndrome | Nearest acup. point | Clinical syndrome |
| | Deeper tissues:<br>M: Levator scapulae<br>N: C3—4 and dorsal scapular C5 | | | |
| B6 | M: Trapezius<br>N: Accessory (XI)<br>Deeper tissues:<br>M: Infraspinatus<br>N: Suprascapular (C5—6) | Cardiac syndromes | Si10 (Si11) | Muscular pain in shoulder and scapula; neuralgia in scapula and forearm. (++) |
| B7 | M: Trapezius<br>N: Accessory (XI)<br>Deeper tissues:<br>M: Rhomboid major<br>N: Dorsal scapular (C5) | Cardiac syndromes | B15 | Cardiac pain. (++) |
| B8 | M: Trapezius<br>N: Accessory (XI)<br>Deeper tissues:<br>M: Rhomboid major<br>N: Dorsal scapular (C5) | Cardiac syndromes | B16 | Cardiac pain. (++) |

of myofascial pain or pain in the referred area or diseased viscus was 100% and 88% respectively for Sola and Kennard and Haugen. The overall correspondence for all 3 sources is 71%.

## IMPLICATIONS OF THE CORRELATION

The close correlation between trigger points and acupuncture points for pain is remarkable since the distributions of both types of points are historically derived from such different concepts of medicine. Trigger points are firmly anchored in the anatomy of the neural and muscular systems, while acupuncture points are associated with an ancient conceptual but anatomically non-existent system of meridians which carry Yin (spirits) and Yang (blood). Despite the different origins, however, it is reasonable to assume that acupuncture points for pain relief, like trigger points, are derived from the same kind of empirical observation: that pressure at certain points is associated with particular pain patterns, and brief, intense stimulation of the points by needling sometimes produces prolonged relief of pain. These considerations suggest a hypothesis: that trigger points and acupuncture

points for pain, though discovered independently and labeled differently, represent the same phenomenon.

Pressure or needling at either trigger or acupuncture points for pain produces a deep aching feeling, which is assumed in Western medicine to be the result of stimulation of an underlying focalized pathological process [13,15] while in acupuncture it is named *tech'i* and is assumed to represent a property of the meridian system [19]. Recent evidence [2] suggests that *tech'i* may be due, at least in part, to a local muscle reflex that grips the acupuncture needle when it penetrates the muscle below an acupuncture point. Why this deep aching feeling is felt at some muscle sites and not others is, however, not entirely explained. It is more likely that, in addition to local muscle reflexes, there is an underlying pathological process that is the basis of the unpleasant feeling produced by pressure or needling.

The nature of this focalized subcutaneous pathological process is still not fully understood. The myofascial trigger points, particularly those found in the lower regions of the back, are sometimes associated with definite nodules of fibrous tissue. Kennard and Haugen [13] have reviewed evidence that these nodules may develop after virus infections and other fever-producing diseases. Copeman and Ackerman [7] believe that trigger points result from febrile disease processes which produce abnormal fibrous nodules that remain for years. Korr et al. [14] propose an alternative hypothesis: they suggest that trigger points develop during the course of growth as a result of musculo-skeletal stresses and strains, particularly associated with the muscles of the back. These trigger areas, they observed, are characterized by abnormal vasomotor and sudomotor activity. It is apparent from Kennard and Haugen's study that trigger zones at the chest and back are rare in infants and common in adults, which may be attributable to inflammation of tissues as a result of disease or to strains on the musculo-skeletal system. The widespread distribution of trigger points associated with referred pain patterns suggests that both mechanisms may play a role.

It is also possible, as Kennard and Haugen have suggested, that the areas at which blood vessels and nerves lie close to the surface, rather than hidden under muscles and other tissues, are particularly susceptible sites for the formation of trigger points. Finally, there is evidence that sites of earlier injury or disease may become trigger points: injured tissues, long after total healing and pain relief, may nevertheless become active trigger points in other pain patterns long afterwards [5,6,16,28,35]. The genesis of trigger points, then, is still largely unexplained, but it is clear that they are commonly found. It is further evident that most trigger points (such as those due to musculo-skeletal stresses and strains) would be relatively invariant from person to person, while a smaller number (such as those due to earlier injuries) would vary considerably.

It is reasonable to assume that trigger points, whether they are fibrous nodules or simply areas of abnormal physiological activity, produce a continuous, low-level input into the central nervous system. Diseased viscera, then, may produce an input which summates with the input from trigger

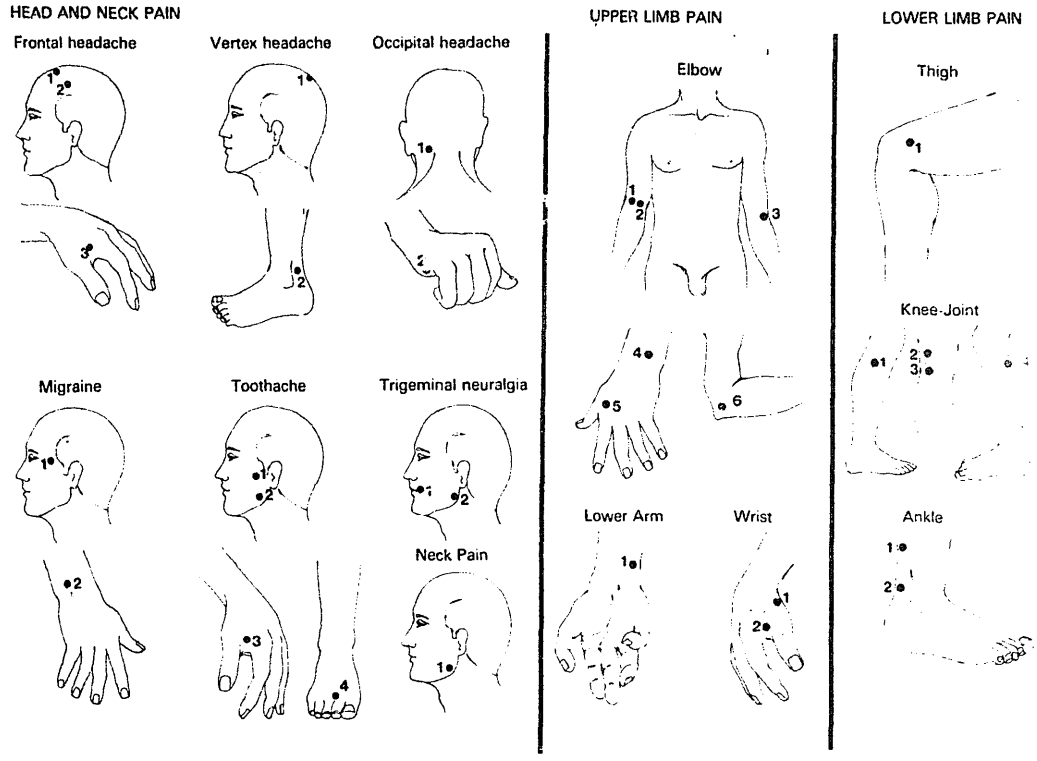


Fig. 6. Acupuncture points associated with head and neck pain, upper limb pain, and lower limb pain. Reprinted, with modifications, from Kao and Kao [11]. The acupuncture points for each syndrome are: *Head and neck pain:* frontal headache, 1-Gv23, 2-S8, 3-Li4; vertex headache, 1-Gv20, 2-B60; occipital headache, 1-G20, 2-Si3; migraine, 1-t'ai yang, 2-T5; toothache, 1-S7, 2-S6, 3-Li4, 4-S44; trigeminal neuralgia, 1-S4, 2-S6; neck pain, 1-S6. *Upper limb pain:* elbow, 1-L5, 2-B3, 3-Lill, 4-T4, 5-Li4, 6-T10; lower arm, 1-H5; wrist, 1-Li5, 2-Li4. *Lower limb pain:* thigh pain, 1-Sp10; knee joint, 1-G34, 2-S34, 3-S35, 4-Sp9; ankle, 1-Sp6; 2-B60. Abbreviations of the acupuncture points: B = bladder; Cv = conception vessel; G = gall bladder; Gv = governing vessel; H = heart; K = kidney; L = lung; Li = large intestine; Liv = liver; P = pericardium; S = stomach; Si = small intestine; Sp = spleen; T = triple warmer; XH = non-meridial point.

points to produce pain referred to the larger skin areas which surround the trigger points. Conversely, stimulation of the trigger points may evoke volleys of impulses that summate with low-level inputs from the diseased visceral structure, which would produce pain that is felt in both areas. Similar mechanisms may account for myofascial pain associated with trigger points. Abnormal input from muscles, tendons or joints — due to sprain, strain, excessive stretch injury, or other unusual activity — may summate with activity from trigger points and produce the pain patterns shown in Figs. 1—5. The pain prevents normal muscular and proprioceptive activity so that the abnormal summation of the two inputs is maintained. When the pain is blocked, even briefly, normal proprioceptive inputs may prevent summation and disrupt the abnormal pain cycle between inputs from the trigger point and those from muscles, fascia, and proprioceptive processes.

These phenomena of referred pain, then, point to summation mechanisms which can be understood in terms of the gate control theory [25].

Two types of mechanism may play a role. The first involves the spread of

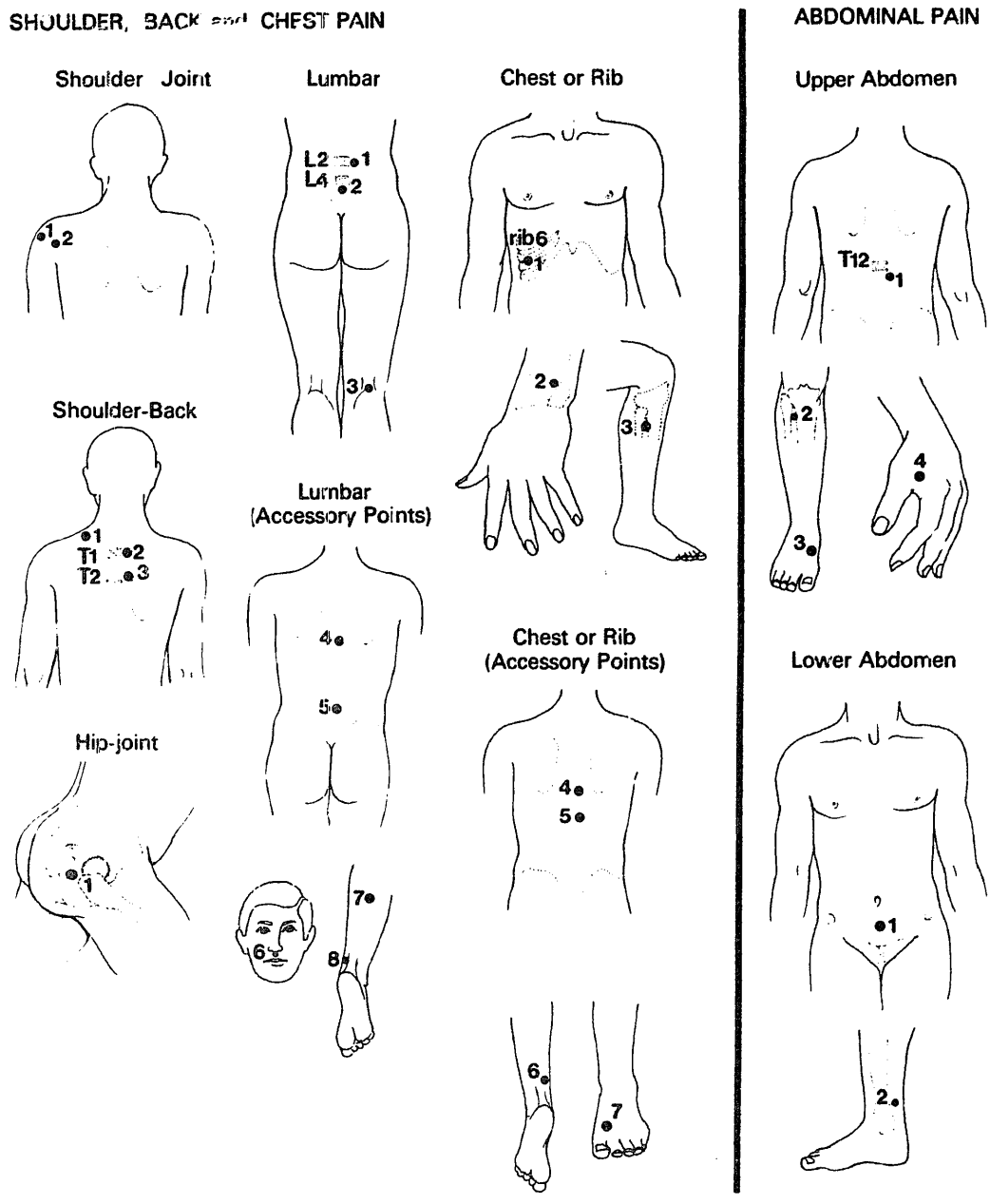


Fig. 7. Acupuncture points associated with shoulder, back and chest pain, and abdominal pain. Reprinted, with modifications, from Kao and Kao [11]. The acupuncture points for each syndrome are: *Shoulder, back and chest pain:* shoulder joint pain, 1-Li15, 2-T14; shoulder back pain, 1-G21, 2-B12, 3-B43; hip joint pain, 1-G30; lumbar pain, 1-B23, 2-Gv3, 3-B54, (accessory points) 4-Gv9, 5-Gv4, 6-Gv26, 7-B57, 8-K3; chest or rib pain, 1-Liv14, 2-T5, 3-G34, 4-B17, 5-B18, 6-Sp6, 7-Liv3. *Abdominal pain:* upper abdomen, 1-B21, 2-S36, 3-Li4, 4-Sp4; pain around navel, 1-S25; lower abdomen, 1-Cv4, 2-Sp6. Abbreviations: see Fig. 6.

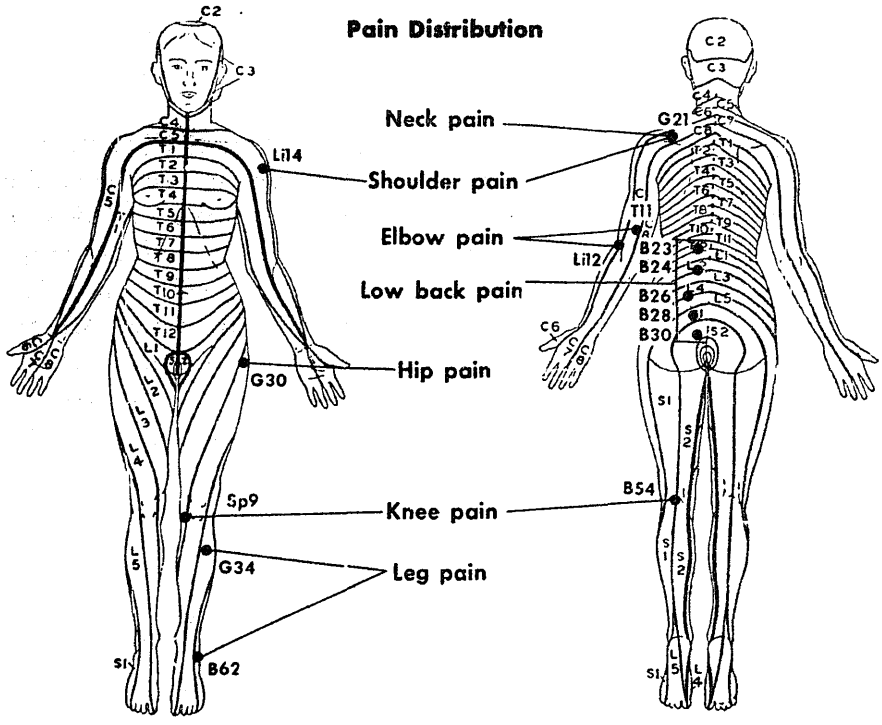


Fig. 8. Basic acupuncture points for pain syndromes which lie on or adjacent to the site of pain. Based on Mann [18,19]. Abbreviations: see Fig. 6.

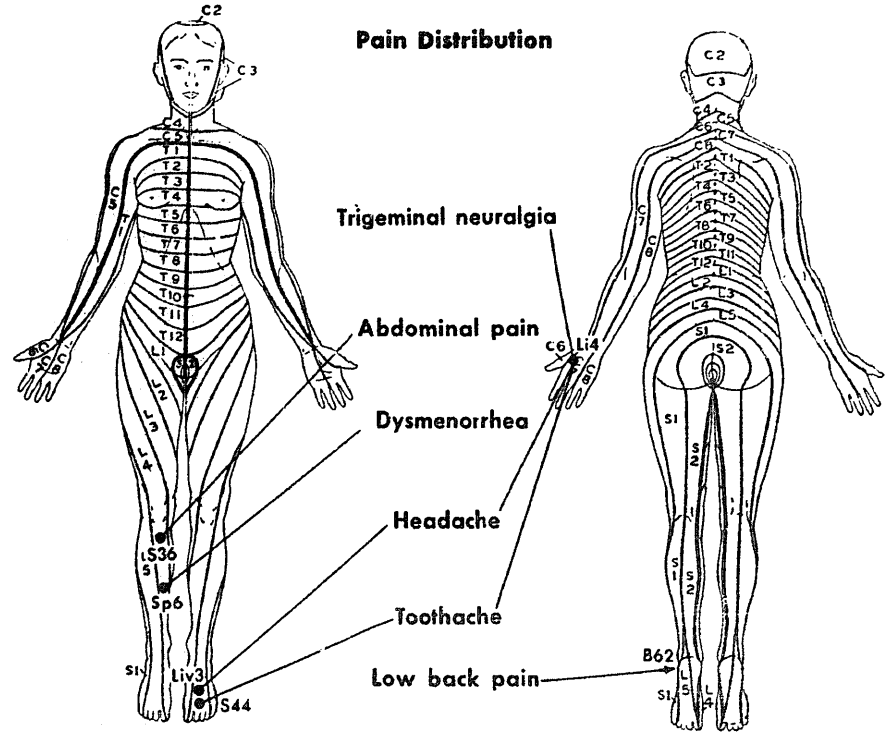


Fig. 9. Basic acupuncture points for pain syndromes which are distant from the site of pain. Based on Mann [18,19]. Abbreviations: see Fig. 6.

pain to adjacent body areas. Transmission cells in the dorsal horns have restricted receptive fields which dominate their normal activities; in addition, however, each cell is also affected by electrical stimulation of afferent nerves that cover a much larger body surface [26]. Melzack and Wall [25] suggest that this diffuse input is normally inhibited, but may trigger firing in the transmission cells if the input is sufficiently intense. Anesthesia of the area to which the pain has spread, which blocks the spontaneous impulses from the area, is sufficient to reduce the bombardment of the cell below the threshold level for pain. The recent discovery [29,31] that small visceral afferents project directly or indirectly onto lamina 5 cells provides further important evidence to explain referred pain. Because lamina 5 cells receive a convergence of somatic and visceral afferents [29,31], they are good candidates for explaining some kinds of referred pain as well as pain of direct cutaneous origin [25].

The second mechanism to explain referred pain involves the spread of pain and trigger zones to regions at a considerable distance, and may include visceral structures as well as cutaneous and myofascial areas. These referred pains suggest that transmission at a given synaptic site can be facilitated by activities in distant body areas. This possibility is consistent with the gate control theory [25] since the substantia gelatinosa at any level receives inputs from both sides of the body and (by way of Lissauer's tract) from the substantia gelatinosa in neighboring body segments. In addition, the substantia gelatinosa of the spinal cord is functionally continuous with that of the trigeminal system [36]. Mechanisms such as these may explain the observations that anginal pain [6] or pressure on other body areas such as the head [8] may trigger pain in a phantom limb.

The relief of pain by brief, intense stimulation of distant trigger points is a major puzzle. The most plausible explanation [23] seems to be that the brain stem areas which are known to exert a powerful inhibitory control over transmission in the pain signaling system may be involved. These areas, which may be considered to be a "central biasing mechanism" [22], receive inputs from widespread parts of the body and in turn project to widespread parts of the spinal cord and brain. It is thus conceivable that the relief of pain by stimulation of acupuncture points and trigger points may be a special case of hyperstimulation analgesia [23]. The stimulation of particular nerves or tissues by needles could bring about an increased input to the central biasing mechanism, which would close the gates to inputs from selected body areas. The cells of the midbrain reticular formation are known to have large receptive fields [30] and the electrical stimulation of points within the reticular formation can produce analgesia in discrete areas of the body [4, 21]. It is possible, then, that particular body areas may project especially strongly to some reticular areas, and these, in turn, could bring about a complete block of inputs from particular parts of the body.

The prolonged relief of pain after only brief stimulation requires the additional postulation of prolonged, reverberatory activity which may be facilitated by low level inputs, such as those from the pathological structures or

processes that subserve trigger points (or acupuncture points), and is disrupted for long periods of times (perhaps permanently) by a massive input produced by needling, or by a total block of input by injection of local anesthetics into trigger points.

This speculation suggests that the observed relationship between trigger or acupuncture points and painful areas at distant sites represents important information of the organization of the central nervous system. Studies on animals reveal some degree of anatomical organization of the "central biasing mechanism" since stimulation at a given site may produce gradients of analgesia in which the maximum analgesic effect is observed in a relatively small part of the body, such as a foot or portion of a leg [4]. Studies of trigger and acupuncture points in man may provide further valuable clues on the organization of this mechanism. These data, moreover, are consistent with earlier observations which reveal unusual interactions between distant body areas [27]. Patients who have undergone anterolateral spinal cordotomy, usually for relief of pain due to malignancy, report pain at some distant area (such as the chest or abdomen) when pricked by a pin on an analgesic area (such as the leg). These pains can be evoked on the same or the opposite side of the body. In some cases, the pain is evoked at the site of an earlier injury [28]. A recent study [32] in normal subjects further demonstrates complex spatial somatic interactions which defy explanation in terms of the traditional segmental organization of the peripheral nervous system. The evidence, taken together, suggests the existence of integrating mechanisms in the central nervous system which permit interactions of inputs from widespread parts of the body.

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