Soft tissue manipulation: diagnostic and therapeutic potential

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INTRODUCTION

Acupuncture, osteopathy, chiropractic, naturopathic medicine, orthopedic medicine, and physiotherapy all pay attention to the diagnostic and therapeutic potential of the soft tissues of the body. These and other similar therapeutic systems have developed methods of identifying those aspects of soft tissue dysfunction which indicate disease or injury or reflex activity of some type. Regardless of the terms used or the theories propounded, all the systems seem to refer to the same phenomenon: distinct, palpable, usually sensitive areas of soft tissue aberration which are either directly or reflexively related to local or organ dysfunction.[1,2]

Soft tissue manipulation may be utilized to:

- normalize dysfunction preparatory to manipulation of osseous structures[9]
- restore postural or functional integrity – achieving what osseous adjustments can seldom achieve: actual alterations in structural position of musculoskeletal segments[10]
- function as part of a comprehensive approach to health care in which the reflex activity, as manifested in surface structures, is used diagnostically and therapeutically.[11]

The distinguished Western acupuncture pioneer, Dr Felix Mann, has stated that, with the vast number of acupuncture and other reflexively active points now charted, there is little, if any, of the body surface left which has not been ascribed therapeutic potential.[12] Thus he maintains that the traditional concept of points and meridians is no longer a valid hypothesis. He concludes that the whole body is, in fact, an acupuncture point. If other systems of identifying discreet areas of reflex potential in the soft tissue, such as Chapman's neurolymphatic reflexes[13] and Bennett's neurovascular reflexes[14] (see below), are

examined alongside both traditional and more recently described acupuncture points, Mann's statement becomes readily acceptable.

Soft tissue stressors

- Congenital factors, such as short leg, small hemipelvis
- Birth trauma, such as cranial trauma from forceps delivery which distorts the internal cranial fascia – tentorium cerebelli and falx cerebri – which, because of body-wide fascial continuity, can cause distortions elsewhere
- Overuse, misuse or abuse of the musculoskeletal system in work or recreational settings
- Habitual postural stress
- Habitual upper chest breathing pattern
- Trauma – either repetitive minor forms or major incidents
- Reflexive factors, including myofascial trigger points and viscerosomatic influences
- Chronic somatization influences generated by negative psychosomatic factors and emotional coping traits, including fear, anger, anxiety, depression, etc.
- Biochemical changes resulting from nutritional, toxic, endocrine, infectious and other influences

Progressive adaptive changes to soft tissue stressors [3–7]

- An initial “alarm” response will occur in which tissues become hypertonic
- If not short term, localized oxygen deficit is probable, together with retention of metabolic waste products, both of which result in discomfort or pain and the likelihood of an increased hypertonic response
- The constant activity of the neural reporting stations of these tissues leads to increased sensitization and the development of a tendency to hyperreactivity (known in osteopathic medicine as “facilitation”)[8]
- Macrophages become activated – along with increased vascularity, fibroblast action and connective tissue production – leading to cross-linkage and shortening of tissues
- Changes in the muscles as a result of hypertonicity which, if sustained, results in progressive fibrotic modification
- Sustained hypertonicity leads to drag on tendinous attachment to the periosteum, and the likelihood of pain and dysfunction in these tissues
- If such stressed tendons or muscles cross joints, they become crowded and their function is modified
- The antagonists of chronically hypertonic muscles will be reciprocally inhibited and, as a result, normal firing sequences of muscles may alter – e.g. where excessive activity of synergist muscles occur in order to take on the tasks of weakened (inhibited) prime movers, or synergists
- Chronically shortened hypertonic structures have a sustained inhibitory effect on their antagonists – an example would be short, tight, erector spinae muscles and weakened (inhibited) abdominal muscles seen in the typical ‘slouching, pot-bellied, sway-back, posture; another example would be the inhibition of deep neck flexors associated with short tight neck extensor muscles, seen in the typical ‘chin-poke’, head position.

- Chain reactions of such dysfunction can occur resulting from the shortening over time of postural muscles (type 1 fibers) and the inhibition and weakening (without shortening) of phasic muscles (type 2 fibers)
- Localized areas of hyperreactivity (facilitation) may evolve paraspinally, or in particular stress-prone regions of any myofascial structures – trigger points and other reflexively related changes
- These triggers themselves commonly become sources pain and of further dysfunction
- Postural and functional changes will become apparent throughout the body, e.g. in relation to breathing pattern dysfunction (‘upper chest breathing), which can result from (for example) poor, slumped posture, and which cannot be easily normalized until the structural changes which encourage it are corrected.
- Therapeutic input in response to such changes needs to address the multiple changes which have occurred – to reduce hypertonicity, resolve fibrotic changes, lengthen shortened structures, tone weakened/inhibited structures, mobilize joints, deactivate trigger points – as well as removal of habitual patterns of use which have added to, or caused, the dysfunctional patterns, including postural and respiratory re-education
- The musculoskeletal changes described above may have components which include biomechanical, biochemical and psychological components, all of which need to be understood and, where possible, modified or removed

SOFT TISSUE POINTS

A degree of reductionist thinking is necessary to understand the nature and value of the reflex areas, points, and zones that have been described by the many systems of soft tissue manipulation.

In general, these points can be divided into sensitive soft tissue alterations that result from physical strain or trauma (including the soft tissue effects of emotional stress) and alterations which are the result

of reflex activity (e.g. viscerosomatic reflexes). These changes can be considered as adaptive responses to patterns of stress as outlined above.

Methods of identification

There are a variety of methods by which soft tissue changes may be located through palpation. These include:

- traditional massage methods
- specific palpation techniques, such as those developed by osteopathic and other schools[15]
- neuromuscular technique (a method of combined assessment and therapy developed in the 1930s by Stanley Lief, an American-trained naturopathic and chiropractic physician working in Europe)[11]
- skin distraction techniques evolved by the German connective tissue massage (Bindesgewebsmassage)[16] practitioners (see “Hyperalgesic skin zones”,

All of these, and other methods of palpation, may be utilized in order to identify areas of local soft tissue dysfunction which may be sources of, or results of, reflex activity or other local adaptive responses.[17]

The analysis of the available information present in localized areas of the soft tissues requires consideration of a variety of classifications and systems.

It is necessary to examine some of the systems which have described the same tissue changes in different ways, in order to compare the similarities and differences in the descriptions of “points” (discrete, usually sensitive, areas of altered structure and function in the soft tissue) and the diagnostic and therapeutic significance ascribed to them.

GENERAL SOFT TISSUE MANIPULATIVE TECHNIQUES [81]

Therapeutic effort may be directed toward the diagnosis and correction of the mechanical aspects of dysfunction (trauma, strain, etc.) or toward the use of the available information from such reflex areas in a more wide-ranging, holistic approach to the health of the patient.

General, rhythmic techniques are often employed on the soft tissues to relieve local dysfunction and/or to prepare for subsequent adjustment of osseous structure.

In all of these variations, the objectives are the improvement of circulation and drainage, release of con-tracture, and increased range of movement. Inhibition implies a degree of pressure sufficient to achieve reduction in hepertonia or neurological activity. All of these may be applied in a stimulatory as well as a relaxing manner, but care should be taken to prevent stimulation from becoming irritation.

DISCRETE PALPABLE POINTS RELATED TO TRAUMA OR STRAIN

Researchers and clinicians have used differing terminology to describe similar phenomena, resulting in confusion of what is essentially an uncomplicated pattern.

In the musculature and connective tissues of the body, often in the regions of the origins and insertions of the muscles, there are palpable, sensitive areas of altered structure resulting from injury, irritation, stress, etc. These have been described as “tender” points,[18] “trigger” points,[19] ”Ah Shi” points in traditional acupuncture (literally spontaneously tender points’),[19] and “indurated” points,[20] among other descriptions.

Common to these points is their size, which ranges from 0.5 to 1.0cm across, and their feel, which is described as harder or firmer than surrounding normal tissue, or as having an edematous or stringy feel.[18–21]

It is often noted that these localized areas of altered structure and function occur in bands of stressed fibers, both fascial and muscular. In all cases, such localized areas are, to a greater or lesser degree, sensitive or tender out of proportion to the degree of pressure exerted.[22] All these points are potential “trigger points”, but only those which, upon pressure, are noted to refer pain or other symptoms, to a distant (target) area, that are recognizable as ‘familiar’ to the individual, are so classified.[23, 82]

Identification of these points as areas of localized dysfunction is dependent upon palpatory literacy –

the ability of the examiner to readily distinguish between the texture and other characteristics of normal and abnormal tissues. Development of such a degree of sensitivity is a matter of practice and is readily acquired by any practitioner willing to spend but a little time touching, feeling, assessing, comparing, and judging what it is that is being felt.[15] In most, but not all, cases, these altered areas of structure and function are found to lie in shortened muscle tissue or fascia.[21,22, 82]

The morphology of acupuncture points has been analyzed and described by various workers. Bossy[23] has noted that all of the maxima points described by Head,[24] the motor points of medical electrotherapy,[25] and fully 70% of Travell's trigger points,[26, 82] are all acupuncture points described in Traditional Chinese Medicine.

As will be noted in the discussion below, there is also a large degree of overlap between these and points described in reflex systems, such as Chapman's neurolymphatic reflexes[13] (which include all the traditional acupuncture alarm points) and Bennett's neurovascular reflexes[14] (which includes all traditional acupuncture "associated" points).

Bossy notes that the common structures found under all acupuncture points include neurovascular structures, connective tissues, and subcutaneous fatty tissues. The connective tissues are thought to be vital in producing the acupuncture sensation noted as being essential to effective therapy.[27] These structures impart the "gripping" of the needle, and the manipulation of the needle affects, through localized tissue traction, minute neural reporting stations, such as Meissner corpuscles, muscle spindles, and Golgi tendon organs. Since many of the systems of reflex soft tissue manipulation (strain/counterstrain, etc.) maintain that it is just such neural structures which produce the reflex effects in their methodology,[8] there appears to be common ground between acupuncture and these other systems. This similarity is found in both the identification of the reflex structure (acupuncture point, trigger point, tender point, etc. being the same phenomena in different systems of classification) and, at least in part, the element which acts to convey reflex benefits (e.g. Golgi tendon organs).

There are other features of connective tissue that are capable of resulting in either excessively increased general tone, or in localized areas of soft tissue distress and dysfunction.

Staubesand & Li [85] [86] studied the fascia cruris in humans with electron photomicroscopy and found large numbers of smooth muscle cells, embedded within the collagen fibers. They described a rich intrafascial supply of capillaries, autonomic nerves and sensory nerve endings and concluded that these intrafascial smooth muscle cells enable the autonomic nervous system to regulate a fascial pre-tension, independently of the muscular tonus. They suggest that this understanding of fascia as an actively adapting organ may have far reaching clinical implications. [86] One such implication is spelled out in the influence of blood pH on smooth muscle status/tone. Alkalosis increases smooth muscle contraction/spasm (for example worsening symptoms of asthma)[87] Breathing pattern disorders, such as commonly occur with anxiety and hyperventilation, lead to excess CO2 exhalation, increased alkalinity, and automatic smooth muscle contraction, so affecting the overall tone of connective tissue, particularly involving the smooth muscle cell tissues, embedded in the fascia.[83] It is therefore unsurprising that pain and trigger point activity often emerges from a background of anxiety and breathing pattern imbalance.

Point classification systems

In an attempt to make sense of the vast amount of information available from soft tissue changes, a number of systems have been developed that classify variations in significance, role, potential for therapy, etc. Some of these are described below.

All such points are sensitive to pressure, but some also refer symptoms to a distant site when stimulated. The latter are trigger points if the pain is familiar to the individual, and the former are potential or latent trigger points. [82] These may be classified in a variety of manners depending upon the system in question.[17,28]

Tender points

In the system of soft tissue manipulation named strain/ counterstrain, described by Lawrence Jones,[18,29] the tender point lies in a particular area in relation to any strain of a given joint or area. This is often found, not in the area complained of by the patient, but in shortened tissues associated with the strain. Thus, in flexion strains of the low back (strains which occur in a forward bending position), the appropriate tender points will almost always be found on the anterior surface of the body, i.e. around the lateral abdominal region or anterior pelvis, despite the patient reporting back pain. On palpation, these anteriorly located points are reported to be extremely sensitive, although the patient is seldom aware of them prior to their being palpated. Jones's method is to maintain palpatory contact with the tender point while repositioning the patient's body in such a manner as to reduce the reported sensitivity from the point. This position of relative ease is then maintained for some 90 seconds while the neurological reporting stations in the injured tissues re-establish a balanced feedback to the CNS (central nervous system), with resulting release of spasm or contraction. No further therapy is required, since this will usually achieve release of soft tissue dysfunction resulting from strain, and a return to normality.

In many cases the position of ease mimics or exaggerates the position in which the original injury occurred, or the position into which the patient is distorted by the contraction or spasm. Thus, an individual unable to stand erect (due to low back strain, for example), may be placed in a position of increased flexion while the palpation of the tender point is used to "fine tune" the exact position of maximum ease of pain at that point. There is recent evidence confirming the value of these safe methods in bedridden, hospitalized patients.[29]

The points described in this method are similar to those known as Ah Shi points in traditional acupuncture.[19] Almost identical criteria are used to identify spontaneously sensitive Ah Shi points, which are then utilized for acupuncture or acupressure therapy (see below). It is reasonable, therefore, to

suppose that the maintenance of inhibitory pressure on the tender point is itself of some therapeutic value, inducing a degree of local and reflex inhibition. Jones denies that this is the intention, stating that he considers the pressure used in his system to be purely diagnostic,[18] but it must remain a strong probability that reflex inhibition of neural activity in the point is occurring as a result of this pressure, since evidence exists supporting the efficacy of pressure techniques in inducing pain relief in such conditions.[30,31]

Indeed, animal studies[30] suggest that pressure techniques have a greater degree of efficacy in promoting endorphin release and ultimate pain relief than does needling. Since Chinese texts describe pressure or needling of points as having the same pain-relieving effect, it is reasonable to assume that endorphin and/or enkephalin release is an important mediating element in such relief.[32] In the experiments mentioned above, artificial CSF was perfused through the lateral ventricle of a donor rabbit while it was receiving finger pressure acupuncture. When this perfusate was injected into a recipient rabbit, a pain threshold increase of 82% was noted. When CSF from a non-treated rabbit was similarly injected, no change was noted in the pain threshold. Highly significant changes were thus noted involving what is assumed to be met-enkephalin. The research group at the Peking Medical College stated:

From the historical viewpoint, finger pressure was probably the most ancient methods of acupuncture. In our own experience the feeling of soreness and swelling stirred by finger acupuncture was sometimes even keener than that experienced in traditional needling, whereas the local tissue damage was much less with finger-acupuncture.

Trigger points [81 82]

A trigger point is a localized palpable spot of deep hypersensitivity from which noxious impulses bombard the CNS to give rise to referred pain and other symptoms. Trigger points as described by Simons, Travell and others [82] are responsive to pressure techniques, to spray and stretch methods (see

below), to injection with procaine and other anesthetics, and to acupuncture (dry needling).[33] Whichever method is used to obliterate the local trigger point manifestation, several important additional measures are called for. One of these is identification of the cause, since, if it is not resolved, relief is often short-lived. Thus, factors such as posture, use of the body (ergonomics applied to sport or occupational habits, etc.), emotional stress, breathing pattern disorders [83], anatomical abnormalities (short leg, etc.), nutritional status, and inherited elements all require analysis, in this as in all areas of somatic dysfunction.[28]

It is also necessary to normalize the ability of the muscle(s) in which the trigger(s) are located so that they can subsequently reach normal resting length.[21,30,34] Trigger points are not found in muscles able to achieve their normal resting lengths. Trigger points are localized foci of neurological disorder that continue to bombard the CNS and, reflexively, their target tissues until removed by therapy. Without therapy they are usually self-perpetuating, unless the factors that caused them (overuse etc) are removed.[17] Once a trigger is appropriately treated, the muscle in which it lies should be examined for other trigger points, and target tissues should be searched for “satellite” triggers.[17,21]

Travell and others have reported a wide range of symptoms in target tissues associated with trigger point activity, including pain, local vasomotor disturbances (abnormality in pallor, coldness, cyanosis, flushing, etc.), increased or decreased sweat production, and pilomotor activity (all via autonomic nervous system involvement).[35] Gutstein[36] reports trigger point involvement in production of a wide range of symptoms, such as menopausal hot flushes and other pre- and post-menopausal symptoms (triggers noted in occipital, cervical, interscapular, sternal, and abdominal structures) and gastrointestinal symptoms, including pylorospasm, halitosis, regurgitation, heartburn, nausea, distension, constipation, and diarrhea (triggers noted in the lower sternum, epigastrium and parasternal regions).

The ramifications of trigger point activity are now known to extend beyond musculoskeletal pain syndromes, as an example the study by Weiss [84] showed that following treatment of myofascial trigger points, by means of manual physical therapy to the pelvic floor, of 42 patients with the urgency-frequency syndrome (with or without pain), 35 (83%) showed moderate to marked improvement or complete resolution, while 7 of the 10 (70%) patients with interstitial cystitis had moderate to marked improvement. It is worth noting that the mean duration of symptoms before treatment, in those patients with interstitial cystitis and the urgency-frequency syndrome, was 14 (median 12), and 6 years (median 2.5) respectively.

Treating triggers

Direct local pressure starts the process of removing trigger points. It should involve enough pressure to produce the referred symptoms and then be maintained in a make-and-break pattern (5 seconds on and 2–3 seconds reduced by about a third) until symptoms noticeably lessen or tissue changes are palpated.[29,37] This is followed by chilling of both the trigger and target area with fluoromethane spray (or ice) together with simultaneous and subsequent stretching of the involved muscle in order to achieve a normal resting length.[17,21,34,38] Mennell[22] advocates the spray and stretch methods, as does Travell, as part of the method used for obliteration of active trigger points. Many practitioners, such as Gutstein,[36] advocate injection into trigger points of anesthetic substances (procaine, etc.) and some, such as Dittrich,[39] advocate surgical excision. Another alternative, after identifying and ischemically compressing (inhibiting) the point described above, would be to place it into a position of ease (as in the strain/counterstrain methodology discussed earlier) prior to stretching the muscle housing the trigger points.[40,41]

Whichever method is used, stretching of the muscles involved to induce a return to normal resting length is usually necessary to ensure complete removal of the trigger. To achieve this, a number of methods, apart from standard active and passive stretching techniques, have been developed. Among

these is the muscle energy technique.

Rather than deactivating a trigger point an alternative approach might be to attempt to remove or modify the stress patterns that have caused, or which perpetuate, trigger point activity. New Zealand Physiotherapist, Dinah Bradley [78], an expert in breathing rehabilitation, identifies key trigger points in her patients, at the outset of their course of breathing rehabilitation. She asks them to ascribe a value, out of 10, to the trigger point when under 4kg of digital pressure. This is done before the patient commences the exercise and treatment program (i.e. no direct treatment is given to the trigger points themselves), with retesting periodically during the course, as well as at the time of discharge. She states, "I use trigger point testing as an objective measurement. Part of [the patient's] recovery is a reduction in musculoskeletal pain in these overused muscles. I use a numeric scale to quantify this. Patients themselves feel the reduction in tension and pain, a useful subjective marker for them, and an excellent motivator."

Muscle energy techniques

A potentially stressful physical therapy modality, known as proprioceptive neuromuscular facilitation (PNF), involving full-strength muscular contractions, has evolved into a gentler (very light contractions) method in osteopathic methodology, now called muscle energy technique (MET) or hold reflex technique.[42,43] It is aimed at restoring shortened, tight structures to a normal resting length, although variations exist aime at toning inhibited musculature.

A vast amount of research and clinical investigation into the value of this method has been conducted in Europe, mainly in Scandinavia and Czechoslovakia.[1,43] The muscles requiring muscle energy attention are identified by standard orthopedic tests for length, and by palpation. Additionally, dysfunctional muscles can be identified by reading the firing sequence of muscles in particular movement patterns.

For example, in the prone position, if the leg is elevated (hip extension) the firing sequence when normal is gluteus maximus, hamstrings, contralateral and ipsilateral erector spinae. If this is palpated as anything else, commonly hamstring and erector contraction and subsequent gluteal firing, the implication is that there is overactivity in the erectors and hamstrings, and inhibition of the gluteals, with a requirement for normalization of the overactive muscles – using muscle energy procedures, or other approaches.[44]

Another common imbalance is evaluated in the lateral recumbent position (side-lying) practitioner stands facing the patient's back or front, at hip level, palpating gluteus medius, TFL and QL simultaneously. The patient abducts the upper leg. In balanced abduction gluteus medius fires first, with TFL operating later in the pure abduction of the leg. Quadratus lumborum should not become active until the leg has reached 25° to 30° abduction. When it is overactive QL will often fire first along with TFL. This evidence suggests shortness in QL (and therefore impacts on breathing as QL merges with the diaphragm as well as acting to stabilize 12th rib on exhalation), and probable inhibition of gluteus medius.

This type of functional evidence of imbalance directs the practitioner toward those tissues in most need of rehabilitation. Once over-tight, or shortened, muscles have been relaxed and released, there is automatic toning of their previously inhibited antagonists. It is at this stage that rehabilitation can achieve results, as the individual learns better patterns of use and posture.

MET

Muscle energy technique involves the use of two physiological phenomena: post-isometric relaxation and reciprocal inhibition. When a muscle is held in isometric contraction, its release is followed by a degree of relaxation not present prior to the contraction.[28] Thus, when muscle fibers contract, but approximation of the origin and insertion is prevented by an exactly equal counterforce, usually

provided by the operator (i.e. an isometric contraction), and this contraction is maintained for a specific length of time (typically 7–10 seconds) after which relaxation is allowed, there will occur a marked release of hypertonicity in the tissues. This allows a greater degree of pain-free stretch to take place in the shortened fibers.[1,45] A new, but probably as yet still limited, resting length is then achieved, and this is used as the starting position of the next isometric contraction. This phenomenon of post-isometric relaxation (PIR) is used to sequentially stretch tight musculature in which triggers are found.[1,43] If the tight or shortened tissues are too sensitive to allow active isometric contraction, then their antagonists are contracted isometrically, producing the phenomenon of reciprocal inhibition which is similarly used to gradually increase normal resting length in the shortened structures.[1]

There are a number of variations in muscle energy technique. It is extremely gentle, utilizing only a small percentage of available strength (unlike PNF), which makes it applicable to almost any condition of soft tissue dysfunction, either alone or in combination with pressure or other techniques.[28]

Variations

Whereas isometric contractions can lead to post isometric relaxation, or reciprocal inhibition, of involved musculature, isotonic exercises have other potentials. For example, a method known as ‘slow eccentric isotonic stretch’ (SEIS) involves the patient engaging a restriction barrier and then attempting to maintain that barrier position (using between 40% and 80% of available strength) while the practitioner *slowly* overcomes this resistance, returning the area to neutral by eccentrically stretching the contracted antagonist.[79]

The purpose of this technique is to facilitate (tone) the muscles being slowly isotonically stretched, (antagonist to shortened muscles), while at the same time reciprocally inhibiting the shortened muscles, so that it can subsequently be more easily stretched. The indication for this arises when there is a need to release tension in individual or multiple muscles (ideally hypertonic postural muscles), while simultaneously toning their weakened/inhibited antagonists.

MET and joints

Hartman[1] describes the use of muscle energy techniques in the preparation of a joint for manipulation. The joint is placed in the appropriate position for adjust- ment, and the patient is then asked to push against the contacting hands of the operator, so that an isometric contraction develops in the tissues surrounding the joint or area being adjusted. After this contraction is released, the degree of "slack" available to the operator will be greater, and the joint will be more easily and effectively adjusted. Indeed, adjustment often occurs during the isometric contraction described

Zones of irritation

Dvorak & Dvorak[17] have described a system which identifies localized areas of spinal sensitivity. In this system, zones of irritation (ZI)[46] are identified by palpation in the paraspinal tissues. These appear in most respects to correspond both with the paraspinal acupuncture points described in the 2nd century AD by Hua Tuo[19,47] and with Jones's tender points.[18] In acupuncture, they are needled or pressed to produce appropriate local and distant effects.

In Dvorak's method, the zones of irritation are used to identify the ideal manipulative direction for adjustment. They are contacted by a palpating thumb or finger (as in Jones's method) and pressure is exerted against the spinous process adjacent to the ZI in such a manner as to reduce their sensitivity. This is considered to be the direction of desirable adjustment. A marked similarity with the method described by Morrison (discussed below) and with strain/counterstrain techniques is recognizable.

Dvorak elaborates on the ZI phenomenon by describing what are termed spondylogenic reflex syndromes,[48] in which ZI in specific paraspinal sites are noted to produce particular patterns of dysfunction in other spinal structures, including muscle groups and vertebral regions.

Induration technique

This method, which describes almost precisely the same technique as that advocated by Dvorak, was developed by Marsh Morrison DC in the 1940s.[20] The sensitive paraspinal point is identified and a push (not an adjustment) is made on the adjacent spinous process until a direction is found in which sensitivity reduces, or tissue release is noted. The pressure is then held for a not less than 20 seconds and no other therapy used. Release of the contracted tissues and lessening of pain on palpation are noted. This is very similar to the Jones's method and is ideal for use by therapists not qualified or licensed to manipulate the osseous structures.[28]

Nimmo's receptor tonus technique

Other workers, such as Raymond Nimmo DC, who developed the receptor/tonus technique, have described similar variations on the theme of identification and normalization of local areas of soft tissue dysfunction using pressure and stretching methods.[49] Nimmo maintained that pressure on such points should last no more than 5–7 seconds and that further pressure was likely to injure tissue. Triggers thus treated would, he maintained, subsequently resolve. He also advocated stretching of the structures. His pressure was delivered by the use of a rubber-tipped wooden instrument, a T-bar, held in the palm of the hand in the interest of reducing stress on the operator's digits.

Different muscle types

In all of these systems, the tissues in which points are found are described as having a characteristic shortened or tight feel, and the work of Lewit[1] and Janda[50] helps to explain why these are found mostly in particular muscles. Janda states that there are two basic muscle activities and types: those which are predominantly postural and others which are mainly phasic in action.

Postural muscles include:

- tibialis posterior
- gastrocnemius-soleus
- rectus femoris
- iliopsoas
- tensor fascia lata

- hamstrings
- short thigh adductors
- quadratus lumborum
- piriformis
- some paravertebral muscles
- pectoralis major (and perhaps minor)
- sternocleidomastoid
- upper trapezius
- levator scapula
- flexors of the upper extremity.

These are all prone to shortening and hypertonia when stressed, abused, or under- or overused.

A number of conditions exist in which specific patterns of dysfunction are associated with shortening of such muscles (e.g. iliopsoas, piriformis, tensor fascia lata, and iliotibeal band), treatment of which is possible using variations of the techniques discussed here (neuromscular technique, muscle energy technique, etc).[11,28]

The phasic muscles include:

- tibialis anterior
- the vasti
- the glutei
- abdominal muscles (mainly the recti)
- lower stabilizers of the scapula
- some deep neck flexors
- extensors of the upper extremity.

These all tend to hypotonia, weakening, and atrophy under conditions of under- or overuse, or abuse.

Janda asserts that before any attempt is made via exercise, etc. to strengthen weakened musculature, it is critical for the shortened antagonists to be stretched and relaxed. Commencing with exercising of the weakened structures is likely to further increase tone in the already tight musculature. Tight muscles act in an inhibitory way on their antagonists, creating hypotonia. This can be altered by normalization of the tight structures. Whether this stretching is achieved by muscle energy methods or active or passive stretching is a matter of choice.

Emotional influence on soft tissues

Selective motor unit involvement [80]

The effect of psychogenic influences on muscles may be more complex than a simplistic 'whole' muscle or region involvement. Researchers at the National Institute of Occupational Health in Oslo, Norway have demonstrated that a small number of motor units in particular muscles may display almost constant, or repeated, activity when influenced psychogenically (for example, a normal individual performing a reaction time task). Using the trapezius muscle as the focus of attention the researchers were able to demonstrate low amplitude levels of activity (using surface EMG) when individuals were inactive but mentally 'stressed'. They explain this phenomenon as follows:

"In spite of low total activity level of the muscle, a small pool of low-threshold motor units may be under considerable load for prolonged periods of time. ….. If tension provoking factors are frequently present and the subject, as a result, repeatedly recruits the same motor units, overload may follow, possibly resulting in a metabolic crisis and the appearance of Type 1 fibres with abnormally large diameters, or 'ragged-red' fibres, which are interpreted as a sign of mitochondrial overload." The implications of this information are profound since they suggest that emotional stress can selectively involve postural fibres of muscles, which shorten over time when stressed.

Summary

The shortened fibers of the soft tissues usually house the palpable and sensitive points, discussed above. These may be the result of a combination of structural anomalies, trauma, and/or physical or emotional stress, and are always influenced by underlying nutritional and behavioral elements. Some of these may be the source of reflex symptoms and pain (active trigger points). All such soft tissue dysfunctions

respond to manual pressure, needling, local anaesthesia, chilling, etc., as well as to release via positional alteration and/or resolution of identifiable underlying or causative factors.

REFLEXES RELATED TO ORGAN OR SYSTEM DYSFUNCTION

Connective tissue massage

The German system of connective tissue massage (CTM)[11,16,28,51] has identified a number of regions or zones which are associated with specific organ or functional problems (e.g. liver zone, constipation zone, arterial disturbance of the legs zone, etc.). Identification of such zones in a patient depends on a method of skin stretching by lifting which indicates the degree of adherence between overlying structures and underlying connective tissue. There is decreased elasticity in areas of dysfunction. Therapy involves a dry contact which lifts and stretches these tissues, producing powerful viscerocutaneous reflex effects. Clinical evidence shows this therapy to be of use in a wide range of problems, as it improves organ, circulatory, and neural dysfunction. A recent hospital study in Scotland indicated CTM to be effective in producing marked reduction in anxiety levels, with resolution of symptoms such as insomnia in patients resistant to drug therapy.[52]

Chapman's neurolymphatic reflexes

Chapman's neurolymphatic reflexes are described in osteopathic literature and involve the use of pairs of reflex points located anteriorly and posteriorly on the body surface.[11,13,28,53,54] The feel of such reflex points is described as similar to that of a nodule, an edematous structure, or a fibrous shotty plaque, depending upon the location.

These reflexes are stated to be the somatic component of lymphatic stasis in associated structures, and treatment of these is felt to assist in resolution of such stasis. A reflex is said to be active if both points of a pair are found to be palpable and sensitive. Treatment is initiated by direct firm rotary pressure, via

finger or thumb tip, on the anterior point for 20 seconds to 2 minutes or until decongestion (tissue change) is noted. The posterior point is then similarly treated. Subsequent re-examination of the anterior point of the pair is conducted to ascertain whether sensitivity is still present. If sensitivity is not present, then successful resolution of the associated lymphatic stasis is anticipated. If sensitivity is still noted, however, then it is considered that pathology is too great for this method to be effective and that other therapeutic input is required. This makes the method a useful prognostic indicator, whether or not the reflexes are used therapeutically in the manner described.

When methods such as hydrotherapy, botanical medicine, acupuncture, massage, or nutritional adjustment or supplementation are utilized to treat a particular condition, the activity and sensitivity of Chapman's neuro-lymphatic reflex points may be monitored in order to assess progress. Also, since these points become active long before symptoms are obvious in associated structures or organs, this method is of significant early diagnostic and prognostic value.

These reflex pairs have been studied in hospitals by the osteopathic profession and were found to be powerful reflex areas. Whether or not the influence is directly on the lymphatic structures is a matter for debate.[55] Points are utilized therapeutically in groups associated with systems, such as the respiratory or gastrointestinal systems, rather than as individual pairs of points. There are some 50 pairs of points, many of which are identical to acupuncture points in location, if not in ascribed areas of influence. Their location and corresponding organ, tissue, system, or symptom are clearly outlined and diagramed in Chaitow[28]

Bennett's neurovascular reflexes

This is a system which utilizes reflex areas, mainly on the abdomen and head.[14,28] It was developed by chiropractic practitioner, Terence Bennett, and involves identifica- tion of localized areas of dysfunction (points) which are contracted or indurated, and which display increased sensitivity. These are said to be related to vascular dysfunction. Therapy is via gentle skin distraction over the point, until a pulsation is

noted under the palpating digit.[56] Contact is made from a few seconds to several minutes in order to achieve this reflex effect. Many of the points are used purely diagnostically and others are used both diagnostically and therapeutically.

Cross-fertilization of systems

Systems such as applied kinesiology,[57] touch for health,[56] and sacro-occipital technique (SOT)[58] have incorporated into their therapeutic and diagnostic methodology the use of many of the reflex points described by Chapman and Bennett.

Alarm and associated points

In acupuncture there exists a series of specialized points in the meridian system, which are found to become sensitive to pressure when the meridian or organ to which they are reflexively connected is distressed.[59] The points which are sensitive to deep pressure are thought to be involved in excessive energy problems, and those noted on light pressure are related to deficiency problems. Many of the neurolymphatic and neurovascular reflexes described above are found to correlate with these two sets of points in location, and sometimes in ascribed effect (alarm points are found ventrally and associated points dorsally). Treatment of these is by needling as appropriate, or by pressure and by attention to the needs of the system correlated to the dysfunction noted.

Tsubo, G-Jo, judo revival, and other point systems related to Oriental medicine

A number of systems (e.g. Tsubo,[60] G-Jo,[61] and judo revival[62]) with common roots in acupuncture employ reflex points in a variety of ways. Some utilize strong stimulation imparted via the thumbnail to produce rapid reflex effects, while others use more gentle pressures. One recently described method indicates a point on the upper lip (Du26) as an ideal locality for strong stimulation in attempting revival of unconscious children suffering grand or petit mal seizures.[63] It was noted in some hundreds of cases thus treated that termination of the convulsion and full revival of consciousness were achieved in an average of less than 20 seconds. The only failures were in children who were not fully unconscious, for

whom the vigorous stimulation was too painful.

Viscerosomatic reflexes

The osteopathic literature describes viscerosomatic reflexes as being localized, sensitive, palpable areas, often found in paraspinal tissues and associated with visceral dysfunction.[64] Beal[65] notes that rigidity is the most common soft tissue manifestation of such a reflex. Initial changes include vasomotor alterations such as increased skin temperature and subtle changes such as increased thickness of the skin, increased subcutaneous fluid, and increased muscular contraction. In chronic conditions, all of these become more evident.

There are usually two or more adjacent spinal segments involved in any viscerosomatic reflex, encompassing, as a rule, the costotransverse junction. Areas which are most frequently involved include T1–T5 (associated with viscerosomatic reflexes from the cardiac structures), T5–T10 (esophagus, stomach, small intestine, liver, gall bladder, spleen, and pancreas), and T10–L2 (large bowel, appendix, kidney, ureter, testes, ovaries, adrenal medulla, urinary bladder, and prostate). There is usually some lateralization, e.g. the liver reflex is found on the right.

For assessment, a springing technique is used in which the palpating hand is slid under the supine patient in order to push upwards on the paraspinal regions. Neuromuscular technique is also an excellent method of assessment of such structures.[11,28] Beal suggests that digital pressure may be used to affect local changes and to reflexively influence the involved organs (somaticovisceral reflex). Since this would have only a moderate effect on advanced organic disease, these reflexes are of more diagnostic than therapeutic value. Also, since they are manifested long before other evidence of organ distress is available, they are useful early warnings of developing dysfunction.[65] Regular assessment of the paraspinal tissues, therefore, acts as a monitor of the internal function. This concept is well documented medically and is of potential value in monitoring the efficacy of any type of therapy, since the reflex condition will show improvement in tandem with the organ state.[66,67] The overlap between these

reflexes and the points and zones described above should be borne in mind

Hyperalgesic skin zones

Overlying all points and zones involved in reflex activity will be noted skin changes characterized by what may be termed hyperalgesia.

There will be a reduced degree of elasticity noted, and this is diagnostic. Lewit[1] maintains that the introduction of a mild degree of stretch into these hyperalgesic skin areas has a powerful reflex effect on underlying dysfunction (i.e. the trigger or tender point, or zone). Assessment is by gentle distraction of the skin in order to compare it with the surrounding skin and the skin in the same region on the contralateral side of the body. Mapping and confirmation of underlying reflex areas are possible by the use of pressure to ascertain sensitivity and possible referred symptoms. Treatment is by maintaining the degree of distraction in the skin zone (fingers pulling gently apart, or, for larger areas, lateral aspects of the hands doing the same) until a degree of release is noted, as the skin relaxes and is stretched to its normal range. This is all the treatment required to normalize the tissues and to introduce reflex changes into the underlying structures.

The maintenance of the restored elasticity depends upon whether the causative factors have also been dealt with, and the degree of activity in associated reflexes.

A number of other methods of normalization can be utilized, including skin rolling, as described in Western and Oriental massage texts.[11,28,68] Chinese massage techniques include pinch–pull techniques which can be used to tonify or sedate the patient and which have marked similarities with German CTM methods. CTM, as described above, involves far more powerful skin stretching methods than either the pinch–pull techniques or Lewit's distraction and stretch techniques.[16]

Neuromuscular technique NMT

The methods of neuromuscular technique involve the systematic combing of the tissues for the soft

tissue changes described above.[11,28,69,70] Its economy of effort and combining of diagnostic and therapeutic procedures have made it popular among practitioners in Europe, where it evolved as a combination of methods derived from Ayurvedic massage,[71] traditional massage, and an American "bloodless surgery" (not to be confused with the Philippine faith-healers' "bloodless surgery") method.[72]

Typically, the thumb tip is used to exert variable pressure on all the accessible origins and insertions and muscle masses in order to identify changes, and, by variations in that pressure, simultaneously treat the recognized abnormalities. This approach is seen as part of an overall assessment rather than as an end in itself. Other methods of traditional massage from both East and West are combined with NMT to normalize those aspects of soft tissue dysfunction which are manifestations of stress, strain, and trauma and to address reflex changes where applicable.

Therapy as a stress factor

Stress is any added load imposed by forces brought to bear on an individual, organ, or tissue. It may be chemical, toxic, psychic, emotional, or physical.[73] Adaptation denotes the ways in which the organism adjusts itself to intrinsic disturbances or challenges. These responses may be short- or long-term in nature, representing the body's homeostatic mechanisms at work.

Selye, in his classic experiments, noted specific and general responses in disease, observing that "stress can either cure or aggravate a disease, depending upon whether the inflammatory response to a local irritant is necessary or superfluous."[74]

Speransky, in his landmark research in the 1940s, stated:[75]

It is obvious from this research that the irritation of any point of the complex network of the nervous system can evoke changes not only in adjacent parts but also in remote regions of the organism.

He continues by observing: "There is a rule that only weak degrees of irritation can have useful

significance, strong ones inevitably do damage."

Many therapeutic measures involve a degree of stress, whether this be an acupuncture needle, surgery, or intake of toxic substances – even in homeopathic dilutions; applications of heat or cold, or electrotherapy; or, indeed in this consideration, manual pressures and efforts. Attaining the desired response, therefore, will depend upon the therapeutic effort not overwhelming the homeostatic potential of the organism.[20] Therapy may be considered to consist largely of the application of graduated degrees of stress, to which the organism responds according to its unique attributes and potentials. Benefit or harm depends upon the degree of that stimulus and, most importantly, upon the vitality of the patient.

The implications for manual therapists are obvious and call for thoughtful application of the varieties of techniques available.

THE POTENTIAL OF SOFT TISSUE MANIPULATION

The professions within medicine which utilize manual therapy, such as physiotherapy, have tended to discard the tradition of "hands on" treatment in favor of a more technological approach, leaving the soft tissues to massage therapists and sports therapists. Osteopathy (as practiced in Europe where it is not a part of a general medical practice, as it is in the US, but rather a system which addresses structural and functional dysfunction via manipulative methods[9,76]) and chiropractic, which are conceived as being largely concerned with the joints and osseous component of the musculoskeletal system, have in recent years come to recognize the vast importance of the soft tissues in both diagnostic and therapeutic roles. The musculoskeletal system is both the greatest energy consumer of the body and its largest organ of sensory input. While this primary machinery of life has long been unappreciated, in therapeutic terms, the development of methods such as strain/counterstrain, muscle energy technique, and neuromuscular technique and the vast amount of information derived from acupuncture tradition and research, and other reflex systems ensure that the diagnostic and therapeutic potential of the soft tissues are now being

recognized and utilized.

Korr,[77] the premier osteopathic researcher of the past three decades, summarizes another vital implication of soft tissue dysfunction – interference with axonal transport mechanisms – thus:

Any factor that causes derangement of transport mechanism in the axon or that chronically alters the quality or quantity of the axonally transported substances could cause the trophic influences to become detrimental. This alteration in turn would produce aberrations of structure, function and metabolism, thereby contributing to dysfunction and disease. Almost certainly to be included among these harmful factors are the deformation of nerves and roots, such as compression, stretching, angulation and torsion that are known to occur all too commonly in the human being and that are likely to disturb the interaxonal transport mechanisms, intraneural microcirculation and the blood–nerve barrier. Neural structures are especially vulnerable in their passage over highly mobile joints, through bony canals, intervertebral foramina, fascial layers and tonically contracted muscles. Many of these biomechanically induced deformations are of course subject to manipulative amelioration and correction.

This survey has touched on some of the many ways in which soft tissue dysfunction may impinge upon the economy of the body as a whole. Soft tissue manipulation is an important diagnostic and treatment modality and should be considered an integral part of the practice of any physician or practitioner whose intent is to care for the whole person. (Those interested in studying this topic in more depth will find references 28 and 81 very helpful. These thoroughly cover the topics surveyed here and provide useful tables, charts and diagrams and pictures of the various techniques as they are applied to a patient.)

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