90 • ACUPUNCTURE

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ACUPUNCTURE is a therapeutic procedure in which small, solid needles are inserted into the skin at varying depths, typically penetrating the underlying musculature. This method, derived from practices in ancient Oriental medicine, was essentially unknown to most physicians in the United States when the first edition of this book was written. Bonica (1) mentioned acupuncture as a form of local therapy and cited its use by Osler for treating various painful conditions during the latter part of the nineteenth century. Because of the publicity given to Chinese demonstrations of acupuncture pain control for surgery in the 1970s, acupuncture has since become familiar both to the medical community and to the lay public. Its practice remains controversial, and in some states nonphysician acupuncturists have won the right to practice their trade either independently or under the auspices of a licensed physician.

Acupuncture is of interest to physicians concerned with pain management in day-to-day practice for two reasons: (a) it offers a comparatively safe alternative to the prescription of medication for pain problems; and (b) patients often ask their primary care physicians for advice on whether they should engage the services of an acupuncturist or for referral to an acupuncturist. It is therefore worthwhile to have a working knowledge of acupuncture techniques, the potential of this approach for pain management, the issues surrounding its putative mechanisms, and its limitations.

This chapter is intended to provide an overview of the current clinical and scientific knowledge base on acupuncture for pain therapy. It consists of two parts, a critical review of current knowledge in the field and a description of a Western approach to acupuncture therapy for musculoskeletal pain. We discuss the use of acupuncture for the control of acute and chronic pain rather than its possible use for the prevention of pain during surgery. Acupuncture pain control in the surgical setting, although now recognized as a valid phenomenon, is of no practical importance in Western medical practice and its adoption in the West is no longer at issue. Bonica (2) has written a definitive report on the use of acupuncture for surgery. Surgical use is of interest only to the extent that it sheds light on the mechanism(s) of acupuncture therapy for pain prevention or relief.

In addressing acupunctural pain therapy, which is practiced widely in the United States, this chapter draws heavily on the research produced in this area since 1980, but, where appropriate, earlier studies are also considered. Ancient Chinese medicine is noted only briefly, because this information is of little relevance and is available in copious detail elsewhere (3–8). The purpose of this chapter is to provide interested physicians with a working knowledge of the field so that they can judge the potential of acupuncture techniques for specific pain management problems.

The material is presented in two major sections: A, Basic Considerations, including the three basic types of acupunctural therapy for pain and the indications for these therapies, a brief description of how acupuncture is performed, a broad review and evaluation of the scientific base for the use of acupuncture for managing pain, and a summary of the current state of knowledge in this field; and B, Acupuncture for Trigger Point Therapy, including clinical uses and a brief guideline for its application to chronic musculoskeletal problems. Chapman wrote Section A, and Gunn wrote Section B.

A. BASIC CONSIDERATIONS

Types of Acupunctural Therapy

Review of the current medical literature reveals that the term "acupuncture" can refer to at least three different interventions: classic acupuncture based on Chinese medicine, acupuncture as a form of trigger point therapy, and acupuncture as a procedure for electric stimulation. These are distinctly different therapies and each must be considered separately.

Classic Acupuncture

The first and best known form of acupuncture is the practice of traditional methods according to the principles of ancient Chinese medicine (8, 9). Taoist doctrine saw human health as existing within the tensions created by opposing forces in nature, the *yin* (dark, female) and the *yang* (light, male). Medical intervention carried out within this tradition was undertaken to balance opposing energy forces considered to be out of harmony. A concept of energy flow that combined circulation and neurologic function was fundamental to the practice of classic acupuncture. Vital life energy was thought to flow through a set of interconnected channels, called meridians, that followed a circadian rhythm.

One of the internal organs was thought to be associated with each meridian, and the meridians are named according to organs. For example, the meridian for the gallbladder runs from the external canthus of the eye, back and forth along the skull, and down to the shoulders, from which it descends along the side of the body and ends at the fourth toe. It is a yang meridian—its function is balanced against that of its yin counterpart, the liver meridian. The latter runs from the great toe to the groin and into the chest, where it is said to disappear from the map of meridians because it courses deep into the body and has no surface representation. Diseases and discomforts such as pain were classified according to the meridians they involved and according to whether they had a yin (cold, hypofunctional) or yang (hot, hyperfunctional) nature.

The meridians were said to be interconnected with the vital life energy, *chi*, flowing through them. Excesses or deficiencies in the flow of energy were said to cause pain, discomfort, hypo- or hyperfunction and, with time, trophic changes. By inserting the needles strategically along individual meridians or at their junctures, the acupuncturist attempted to balance the flow of energy throughout the body.

Numerous variations on classic acupuncture exist. Among them is a system of ear acupuncture based on the belief that the pinna contains a map of acupuncture points representing the entire human body. Research on this type of diagnosis and therapy is limited, but controlled trials have failed to yield supporting evidence (10). The many embellishments of classic acupuncture are outside the scope of this chapter.

Today in the Orient many practitioners still employ classic Oriental medicine principles in the treatment of pain and disease states, which are also popular in many parts of Europe. When Western physicians practice traditional acupuncture it is often based on a "cookbook" approach in which a routine set of meridian points is used to treat each type of pain problem (3, 4). This is neither bona fide Western nor Oriental medicine because classic practice in its pure form emphasizes the unique individual diagnosis of each patient.

Although these and other concepts of ancient medicine were exceptionally enlightened for their time (e.g., they conceived of circulation and certain basic principles of neurology), they are now history. It is hardly surprising that much of the ancient folk medicine cannot be validated by modern science. For example, one organ postulated by the ancient Chinese to affect energy flow, the triple heater, is nonexistent. Similarly, meridians exist neither as anatomic structures nor as patterns of neurologic response. Whereas contemporary studies have shown that acupuncture points are often characterized by low skin resistance and tenderness to palpation, these are also the characteristics of trigger points (Chapter 21). Correspondence between meridian pathways and patterns of referred pain or sensation produced by finger pressure at tender points overlying muscle is not surprising or unknown to Western medicine (11–13). Such correspondences help to confirm that ancient Oriental therapists identified and treated conditions that are still observed and often undertreated today. They do not validate the notion that acupuncture has some special or mysterious origin that gives it an advantage over comtemporary, scientifically based practices.

Variations of traditional medicine exist in a revised form in contemporary medicine in the Far East. For example, Japanese Ryodoraku treatment maintains most of the basic tenets of classic acupuncture, but the mechanism underlying treatment is considered to be the autonomic nervous system (14, 15). Therapists attempt to balance sympathetic and parasympathetic functions of the autonomic nervous system and rely heavily on readings of electric skin resistance at traditional meridian points for diagnosis. Meridians are considered to be patterns of autonomic activation. This and other hybrid therapies offer bridges between classic Oriental and modern science. Unfortunately, such possibilities remain in the realm of conjecture for want of scientific data to support basic hypotheses.

It is difficult to justify the perpetuation of ancient folk medicine concepts, at least in their pure form, in contemporary medical practice, but the romance of the ancient knowledge has gained a strong following among lay practitioners of folk medicine and among some physicians. It is strongly rooted in the culture of several major nations, and in some industrialized countries, including Japan, Chinese medicine is taught in degree-granting institutions. Approximately one-sixth of the world's population relies occasionally on Chinese medicine.

Trigger Point Therapy

The second application of acupuncture is essentially neurologic. Degenerative changes in neural function related to stress, prior injury, and aging can upset the normal properties of skeletal muscle, as well as those of other tissues and organs, in subtle ways that might not be evident on conventional neurologic examination. Abnormal areas of skeletal musculature can be felt as tender, ropy strands or points that are associated with signs of excessive sympathetic activity (e.g., coldness, mild edema), pain on palpation, and general fatigue. Such points have been identified by Bonica (1, 11), Travell and Simons (12), Sola (13), and others as "tender points" or "trigger points" that can be effectively treated by stimulation to achieve relief of persistent pain. Chapters 21, 45, 52, 58, and 77 describe trigger points, their associated myofascial pain syndromes, and treatment of these syndromes.

When acupuncture needles are used to treat the tender points in muscle associated with chronic pain, acupuncture is nearly indistinguishable from trigger point therapy. The close relationship of trigger points as defined by Western medicine and acupuncture points as identified by ancient texts of Oriental medicine has been addressed by Melzack (16) and by Gunn and colleagues (17). Although many trigger point therapists choose to inject local anesthetic or normal saline solution into tender areas, some use stimulation with an acupuncture needle at the same site. Many, like Sola, believe that trigger points are associated with sympathetic hyperactivity and that local chemical blockade of the trigger point eliminates the basic pathophysiology.

The possible mechanisms underlying trigger point therapy have been reviewed in depth by Travell and Simons (12) and by Sola (13, 18). We postulate that such treatment reverses the effects of chronic nerve damage, such as radiculopathy, on skeletal muscle (see below). Pain of this type is almost invariably accompanied by muscle contractures, and pain relief is predicated on the release of painful contractures.

Electric Stimulation Therapy

Electric stimulation for pain relief might be as old as acupuncture itself. Records from the ancient Greeks and Romans indicated that fish that could produce an electric discharge were used to treat patients with pain. During prolonged surgeries in the early 1970s Chinese acupuncturists found extended manual twirling with needles inefficient (and perhaps monotonous as well) and replaced this practice with electric stimulation. In parallel, Western practitioners, inspired by the gate control theory of Melzack and Wall (19), began to develop electric stimulation therapies for pain control. This has led to the widespread use of transcutaneous electrical nerve stimulation (TENS) and the development of an industry in the United States that manufactures TENS units. (TENS therapy for pain is reviewed in Chapter 92).

Little difference in the practice of pain control with TENS methods and with acupuncture has been noted, and research in one area contributes information to the other. The two approaches have in common three sets of parameters for electric therapy: (a) high-frequency, low-intensity stimulation (generally delivered at the area of painful focus); (b) low-frequency, high-intensity stimulation (typically delivered distal to the area of pain, perhaps at a classic acupuncture point); and (c) burst mode stimulation, in which brief bursts of high-frequency stimulation are given. These methods appear to have different effects in different situations. More detailed information on the parameters of choice for electric therapy and the differential application of the three sets of parameters for selective pain problems is presented in Chapter 92.

Acupuncturists differ from TENS therapists in the use of needles rather than broad electrodes and in a general tendency to use electric therapy for systemic rather than local effects, although prominent exceptions to this rule are found. Because needles penetrate the skin and underlying muscle, some therapists combine electric and trigger point therapy.

Procedure

Classic Methods

The insertion of acupuncture needles is not technically demanding, but a surprising variety of techniques exists. Many claims have been made—but with no actual evidence—that different procedures of needle insertion produce different therapeutic results, and acupuncturists do not agree among themselves about optimal needle technique. Many classic therapists think it important to slant the needle either in the direction of assumed energy flow in the treated meridian or against the energy flow, and some use gold and silver needles for special purposes. In some cases mugwort is pressed into a ball and attached to the top of the needle. The acupuncturist lights the herb after needle insertion, and the smoldering material gently heats the inserted needle. These concerns and other exotic refinements related to classic theory are of no practical importance for medical application.

Modern Methods

Figure 90-1 demonstrates a typical procedure used by classic therapists for needle insertion. Individual therapists vary considerably in the way they manipulate the needle during insertion. Some use a lifting-and-twisting-motion, others quickly insert it without rotation, and still others slowly penetrate the skin and underlying tissue. A few therapists penetrate only the skin and contend that no benefit is obtained by stimulating deeper tissues. Others argue that superficial and deep penetration are appropriate for different types of disorders. No "right" way exists, however, and patient comfort is perhaps the most important criterion. Even this would be argued by the few acupuncturists who believe that stimulation of deep muscle and periosteum is of therapeutic benefit.

Students of acupuncture in China typically learn by inserting needles in themselves. This type of practice helps to ensure a technique that is minimally distressing to patients. Some physicians prefer to use needle guide tubes or devices that mount the needle in a guide cylinder equipped with a piston that taps the needle into place at the touch of a finger. Such methods help to minimize the distress of treatment and to maintain sterility. Figure 90-2 illustrates a Japanese needle system. Such equipment lends itself well to Western trigger point therapy; we advocate the use of this type of instrument in the second part of this chapter.

Chinese therapists emphasize the importance of *te chi* at the site of insertion: the underlying muscle appears to grab the needle and hold it firmly. The patient reports a concomitant feeling of heaviness or pressure at the needle. Trigger point therapists such as Sola (13) and Gunn (see below and ref. 72) have noted that the insertion of needles in muscle tissue that is not associated with a trigger point does not produce this response. In most classic practice the therapist does not remove the needle until the *te chi* has dissipated and the needle can be lifted from the tissue without effort.

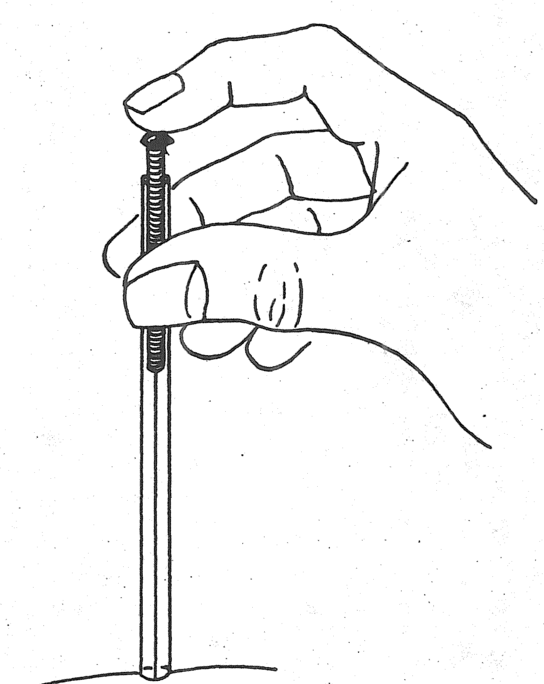

FIG. 90-1. Classic acupuncture needle insertion techniques: The tapping method.

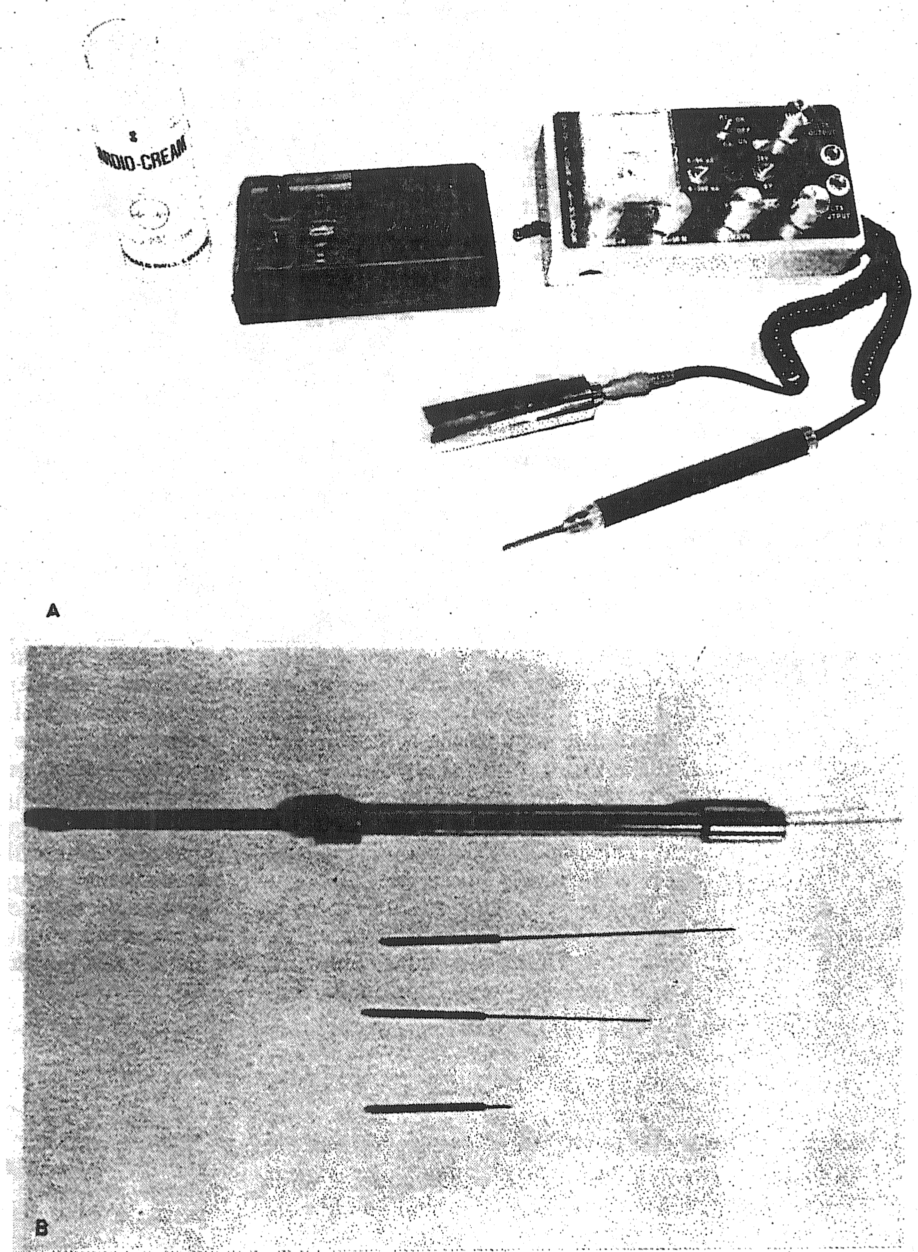

FIG. 90-2. A needle system developed in Japan for acupuncture that is uniquely suited for trigger point therapy. *A.* Equipment to search for acupuncture points. From left to right: plastic container containing conducting cream, a battery pack, and a resistance meter with one lead (heavy upper) held by the patient and the other lead ending as a pencil point probe to detect acupuncture points. *B.* Three disposable acupuncture needles and a needle holder/plunger to assist in needle placement.

The technique used by trigger point therapists for needle insertion has been borrowed from traditional acupuncture. Stainless steel acupuncture needles of three lengths (3, 5, and 6 cm) are commonly employed. The length of the needle is dictated by the location of the point to be treated; deeper and thicker muscles require longer needles. A fine gauge needle—30-gauge or less—with a pointed tip is believed to be less traumatic than the beveled cutting edge of a hollow needle. The fine, flexible needle transmits the nature and consistency of tissues penetrated.

The direction of needle insertion is generally perpendicular to the skin so as to penetrate the muscle zone of innervation. Tubular guides are used to facilitate skin penetration and to avoid touching the needle. We have used multiple needles for the several motor bands within a myotome belonging to both anterior and posterior primary rami that require treatment, but we now prefer the convenient use of only one needle in the plunger-type needle holder, which allows the same needle to be used at multiple loci (Fig. 90-2).

Side Effects and Complications

Potential Complications

As noted above, acupuncture is a potential source of infection if sterile precautions are not taken. If an old, worn needle is employed it can be broken during insertion and require surgical removal. In addition, improper needle insertion can cause pneumothorax. The literature reveals a few cases in which patients have harmed themselves by inserting needles improperly, but few complications of acupuncture when performed by a trained physician have been noted. The safety of the technique compares favorably with the use of prescription medications, trigger point injections, and TENS.

The practice of acupuncture by nonphysicians is a growing concern among physicians as the use of acupuncture spreads. Most nonphysician practitioners are skilled and safe, but the possibility that serious problems might remain undiagnosed in patients under the care of nonphysicians is disquieting. Acupuncture can alleviate or mask symptoms that are of medical importance. Therefore the physician who has a patient who is also being seen by an acupuncturist should be certain that the patient has a proper and thorough medical evaluation and should be alert to the fact that concomitant acupuncture treatment can affect or even suppress the symptoms with which the patient would normally present.

Precautions

It is essential to sterilize acupuncture needles with autoclave or gas because they could transmit hepatitis or other viral disease. The skin should be cleansed with alcohol at the site of treatment. The dangers of acupuncture therapy are minimal when sterile precautions are used. It is important to guard against pneumothorax when placing needles in the chest and shoulder areas, particularly when treating the parascapular and intercostal muscles. Treatment of the trapezius muscle requires particular caution because the patient might flinch with needle insertion, leading to inadvertent puncture of the apical pleura. When treating the lumbar muscles, care should be taken to avoid deep penetration that could injure the underlying kidney. Vasovagal syncope responses are sometimes seen, typically when needles are inserted in the region of the brachial plexus, and it is good practice to have the patient lie down or sit in a supported position. The guidelines offered by Sola and Bonica in Chapter 21 and by Travell and Simons (12) for trigger point therapy are equally suitable for acupuncture.

Scientific Basis: Problems in Scientific Development

Traditional acupuncture is without a scientific basis of any sort (16). Modern research on acupuncture is a formidable undertaking, and work to date has been problematic at both the basic science and the clinical levels because scientific inquiry has not followed a logical progression. Just when the scientific community took interest in acupuncture in the mid-1970s, the raphe-spinal structures were identified as the mechanism subserving opioid analgesia and the enkephalins and endorphins were discovered. Many investigators rushed to hypothesize that endogenous opioids must be the mechanism of acupuncture pain control, and acupuncture research became caught up in the enthusiasm of endorphin researchers for linking all sorts of hitherto unexplainable phenomena to endogenous opioids (20–23). This in turn led the scientific and clinical communities to engage for a time in backward reasoning: acupuncture must be effective because so much work is being done to elucidate its mechanism. Proponents of acupuncture therapy have pointed proudly to animal studies that show links between acupuncture and endorphins, enkephalins, or dynorphins. Whether acupuncture analgesia in humans can be related meaningfully to that in animals has not been considered. This unfortunate unsystematic progression has produced a knowledge base of limited value. To be fair, however, the problem of bias in research is not limited to the acupuncture field—it is well known in the philosophy of science. The tendency to be biased in interpreting scientific data that bear on clinical issues has been described (24), and "confirmation bias" of the sort demonstrated by some acupuncture researchers has been discussed by Greenwald and colleagues (25).

Unfortunately, despite more than a decade of study, the fundamental clinical research questions of whether acupuncture treatment can prevent or relieve acute and chronic pain are still inconclusively answered. Indeed, many of the most basic questions remain unasked. As the review below demonstrates, the literature is far from proving that acupuncture is effective in pain control. The American Medical Association reviewed this issue at its 1981 meeting and decided that insufficient evidence exists to conclude that acupuncture has any more effect on pain than a placebo or sham acupuncture (26). Sweet (27) was less kind, attacking acupuncture as essentially worthless. Clinical efficacy studies have, for the most part, been weak in design, measurement technology, and long-term follow-up. Consequently, it is still not known which acute and chronic pain problems, if any, can or cannot be helped by acupuncture.

Animal, human laboratory, and clinical research studies are reviewed broadly in the remainder of this section. The purpose of these overviews is to encapsulate the scientific knowledge base.

Animal Studies

A comprehensive review of the large literature on animals cannot be undertaken here, and its relevance for the clinician concerned with pain patients is moot. It is important, however, that the clinician not be misled by claims of acupuncture zealots based on data from animal researchers. Although valuable, animal studies shed little light on the value of acupuncture for patient care for the reasons to be described.

Many animal investigations of acupuncture analgesia have been done, mainly with small animals, but a few have used dogs or horses (28–30). Measurement of pain has mostly been restricted to reflex responses or to simple behavioral indicators, such as escape from a stimulus. Only a few studies have tried to define the nature of acupuncture analgesia in a controlled fashion; most have attempted to identify a mechanism. In general, investigators have inappropriately made strong and direct generalizations to humans from animal data without regard to species differences and to the limited relationship of animal laboratory algesimetry models to human chronic pain as seen in the clinical setting.

The results of animal studies are inconclusive as evidence for human study, in part because parallel findings have emerged in the animal literature concerned with acupuncture analgesia and with stress-induced analgesia (31, 32). These findings indicate species-specific responses to acupuncture. When animals are subjected to intensive stress, such as cold water immersion, fright, or painful stimulation, a major hypothalamic–pituitary axis response is produced that includes liberation of cortisols, ACTH, and beta-endorphin, among other substances. Consequently, stress as a physiologic response is characterized by reduced sensitivity to injury or other pain challenge. Such analgesia is typically reversed by the opioid antagonist naloxone (31). In small mammals, such as rabbits, response to a stressor can take extreme forms, which include total immobility.

Frightening a small animal can induce a state popularly called "animal hypnosis" (having nothing to do with human hypnosis), in which the animal is quickly rendered unconscious and insensible (33–35). The more severe the stress, the longer the immobility of the animal, and fear potentiates this immobility response. In nature such animals are often carried off by a predator and left near its den for a later meal. The putative hypnotic state gives them a chance to feign death, effect a recovery, and escape at a later time. This can be demonstrated in the laboratory by simply throwing a rabbit onto its back; one can then carry out an apparently painless laparotomy (34).

Under certain stressful and threatening circumstances, animals in a laboratory setting can go in and out of a putative hypnotic state (35). Because acupuncture is not understood by animal subjects to be benign, the process of handling and painful stimulation with needles can induce a stress response unique to certain species. Support for this possibility was provided by Galeano and associates (36), who performed acupuncture in rabbits while taking care not to induce stress. Under these conditions acupuncture analgesia could not be induced. Thus, animals might not be suitable models for human acupuncture analgesia.

Failure to acknowledge the parallels in animal hypnosis and acupuncture analgesia in animals has led to the emergence of a literature that is difficult to interpret. Nineteen of 22 abstracted articles on acupuncture analgesia mechanisms identified through computer search for the period 1979 to 1983 supported the hypothesis that acupuncture analgesia in animals is mediated by endorphins. In contrast, none of the human research studies addressing the endorphin hypothesis during this period provided positive outcomes.

Human Laboratory Studies

The effects of acupuncture (usually electric) on pain sensibility in normal human subjects has been studied in various laboratory settings. In general, human studies differ substantially from animal work for three reasons: (a) volunteers are not stressed during testing, and every effort is made to ensure their comfort and satisfaction with the experiment; (b) the subjects understand the purpose of the experiment and appreciate the safety precautions taken on their behalf; and (c) more complex measures of pain are employed. Pain threshold, pain tolerance, psychophysical stimulus-matching techniques, visual analog judgments, performance in a sensory decision theory stimulus-judgment task, and brain-evoked potentials have all been used to evaluate the efficacy of acupuncture as an analgesic intervention. Pain has been induced in the laboratory by stimulating teeth or skin electrically, heating skin, immersing limbs in ice water, and applying a tourniquet.

The literature on human studies is less extensive than that on animals but is of sufficient size and complexity to present a full review here. The areas in which the studies have yielded consensus merit comment, however, as does the experience of our laboratory in a long-term research program on acupuncture analgesia. Chapman and colleagues (37–42) stimulated the teeth of study subjects in repeated studies to create safe but noteworthy experimental pain and measured the effects of acupuncture on pain perception using both sensory decision theory techniques and brain-evoked potentials. Consistent observations by Chapman and others include the following findings.

First, outcomes were generally positive although some investigators could not demonstrate alteration of pain perception with acupunctural stimulation (43). Although most studies controlled appropriately for expectancy and placebo effects, it was found that belief in the efficacy of acupuncture can play a role in the subjects' ratings of acupuncture pain control in the laboratory (44). In our laboratory we could observe reliable positive outcomes in a series of four sensory decision theory studies and four evoked-potential studies carried out over a period of several years (37–39, 44). The effect was not seen in every subject, but was typically clear in about 75% of the volunteers in any given experiment.

Second, the effect obtained, although statistically significant, is typically small or even minor from a clinical perspective. In one study we observed that acupuncture analgesia was approximately equal to the effects of inhaling 33% nitrous oxide in oxygen (37). In another study we found that the effects of acupuncture were no stronger than those of TENS delivered at the same sites in the same way (38). Only in rare cases did we see a subject who appeared to become totally insensitive to laboratory pain during electric acupuncture. Other investigators have reported similar findings (44, 45). These results are strikingly inconsistent with the demonstrations of apparently total pain control in the surgical setting in China. They are similarly problematic for the hypothesis that endorphins mediate acupuncture analgesia, because the effect is small. If such stimulation produces an endorphin-mediated response of sufficient strength to permit surgery without pain, it should appear more formidably in the laboratory.

Third, in accordance with observations of Chinese surgeries, laboratory investigators found that the analgesia can be elicited either by stimulating the subject within the same dermatome used for the delivery of the painful stimulus or by stimulating a meridian point (39, 46). The importance of piercing the acupuncture point with precision remains a moot issue. We found that successful demonstration of acupuncture analgesia for dental pain requires exacting care in placement of the needle at the *hoku* point in the hands (located between the thumb and the first finger), but others disagree that this is critical (17).

Finally, electric acupuncture requires low-frequency intense electrical stimulation and appears to be an all-or-none phenomenon. Andersson and colleagues (48) observed that the dental pain threshold could be altered only when the intensity of low-frequency electric stimulation was strong enough to elicit a pounding or throbbing sensation. We found that the evoked potential elicited by painful dental stimulation is reduced only when the acupunctural stimulation is at a level just below the subject's tolerance (40). It was not possible to demonstrate a dose-response effect by varying the intensity of acupunctural stimulation.

Two studies that have contributed uniquely to the laboratory literature merit comment. Chapman and colleagues (41) addressed the question of whether culture affects the response to acupuncture stimulation. Three groups of subjects were studied—non-Oriental Americans, second-generation Japanese-Americans, and Japanese living in Japan. Subjects were required to discriminate several levels of painful dental stimulation in a sensory decision theory task. Detection, discrimination ability, and response bias were measured both in control conditions and during electric acupuncture. Acupuncture yielded small but significant analgesia in all three groups, and neither race nor culture significantly affected the amount of pain control observed.

Price and associates (46) examined the effects of acupuncture on patients with chronic low back pain using a laboratory paradigm. They attempted to bridge laboratory experimentation and clinical pain control by testing patients with an experimental pain stimulus. A hand-held contact thermode was applied to the back and volar forearm of the subjects to deliver noxious heat stimuli. Patients rated both clinical pain and experimental pain under baseline conditions and again after acupuncture. Regardless of whether acupuncture was performed in the dermatomes involved in the back pain or at distant meridian points, both the clinical and experimental pains were reduced 1 to 2 hours after treatment for many patients. When patients were tested again several days after treatment, the therapeutic effect of the treatment on back pain remained but the effect on experimental pain was gone. This study needs to be replicated and extended before firm conclusions can be drawn about the use of experimental laboratory methods with patients, but it suggests that laboratory findings can provide valid evidence for the clinical application of acupuncture.

Whether human acupuncture analgesia is mediated by endorphins has been hotly contested (21, 42). Some investigators have attempted to resolve the issue by measuring plasma endorphins in association with acupuncture therapy, but plasma-borne endorphins cannot cross the blood-brain barrier and therefore are not "functional" in opiate receptor pharmacology. The existence of significant parallels between peripheral and central endorphin changes is still uncertain (23). It is difficult to reach firm conclusions from the evidence on either side of this issue at present; it can be confidently stated, however, that the mechanisms of acupuncture appear to be neither singular nor simple. The complexity increases when these questions are raised at the clinical level. For example, we cannot be confident that the neuropharmacology of the chronic pain patient is the same as that of the normal person or of the elective surgery patient who might respond well when given acupuncture for surgical pain control. Endorphin levels in plasma or cerebrospinal fluid might simply be one part of a larger constellation of neuropharmacologic response to disease, to chronic pain, or to its treatment; they do not necessarily offer the ultimate explanation for pain control during acupuncture.

Clinical Studies

Clinical investigation in the field of acupuncture has been undertaken primarily in the area of chronic pain, with few exceptions (e.g., the study of its effects on postoperative dental pain) (49). Such research has been extremely difficult to carry out effectively for several reasons:

(a) Chronic pain is a complex problem that often has psychologic dimensions as well as organic pathology.

(b) Chronic pain syndromes are sometimes complicated by previous surgeries, other failed therapies, or prescription drug abuse or dependency.

(c) Selection of reliable and valid outcome criteria is difficult, and outcomes are meaningful only when long-term follow-up is undertaken.

(d) No standards are available for correct acupuncture therapy for a given problem, such as back pain.

The last point is particularly problematic. If a cookbook set of acupuncture treatment points is chosen arbitrarily for the target pain syndrome to conduct the study in a systematic fashion, the principles of Oriental medicine are immediately violated. On the other hand, allowing acupuncturists to diagnose and treat each case individually produces a data set that is not amenable to rigorous analysis.

When these major obstacles have been overcome, the investigator must decide whether to use intrasegmental or extrasegmental (meridian) treatment strategies, whether to use electric stimulation and, if so, what parameters, whether to use controls, such as treating patients at the "wrong" points, and how many treatments should be given. A more detailed discussion of these and other design issues in acupuncture research has been provided by Vincent and Richardson (8).

Two types of errors threaten the integrity of any treatment outcome study. The first produces a positive outcome when no real treatment effect exists in nature. Failure to control for placebo effects, unreliable measures, and failure to undertake long-term follow-up can produce such outcomes. The second type is the failure to detect a treatment effect when one has occurred. Too few treatments, too small a sample size to achieve reasonable statistical power, inappropriate or insensitive measurement techniques, and failure to use a homogeneous group of patients can produce misleading negative data. An overview of the large and growing literature in this area reveals that all these errors have been made repeatedly (50). Lewith and Machin (51) have formally addressed the problem of insufficient sample size in the literature. Firm conclusions are therefore difficult to attain. It is clear, however, that acupuncture is not a panacea of sufficient strength to overcome all these problems and to demonstrate consistent and powerful effects on chronic pain.

In addition to small sample size, poor pain measurement has plagued studies of acupuncture therapy. The complexity of clinical pain measurement problems was discussed in detail by Syrjala and Chapman (52) and in Chapter 32. When pain is chronic it is necessary to use both subjective and behavioral outcome indexes tailored to the clinical problem in question, and long-term follow-up must be carried out to determine whether lasting benefits have been obtained. The chances of spontaneous recovery from chronic pain are small by definition, but chronic pain patients can leave any given physician with the polite impression that they have been helped significantly and then go on to another in the never-ending search for a cure. When follow-up procedures such as postal or telephone inquiries about satisfaction with outcome are used, few data of value can be obtained. A rigorous review would dismiss most of the published reports on the basis of these criteria alone.

The earliest clinical studies were largely uncontrolled investigations of mixed groups of chronic pain patients (53). Some early studies used no pain management at all. The data consisted of scaled judgments by the therapists themselves. With time, study designs improved and more suitable but still insufficient pain measurement methods were introduced. The most thoroughly studied clinical problems have been headache and back pain.

A brief review of the field prior to 1976 was provided by Mendelson (53), and more recent reviews have been offered by Lewith and Machin (51) and by Lewith (50). Richardson and Vincent (54) have provided the most comprehensive review to date, with particular emphasis on back pain and headache. They evaluated each of the studies critically on the basis of controls, measurement technology, and follow-up. All of the above investigators deserve credit for their attempts to extract information in a critical fashion from a weak and problematic body of literature. In addition, a few negative reports have been helpful in delimiting the range of effects of acupuncture. For example, Lewith and colleagues (55) concluded that acupuncture is ineffective for postherpetic neuralgia.

What conclusions, if any, can be drawn from the literature? In their review of the overall efficacy of acupuncture therapy, Lewith and Machin (51) concluded that a positive response is given by about 70% of chronic pain patients with the use of real acupuncture, whereas the positive rate for sham acupuncture controls is about 50% and for placebo about 30%. Lewith (50) reviewed the following in detail: six studies that compared acupuncture with conventional medical therapy; ten studies that compared acupuncture with random injection of needles; and two studies that compared acupuncture with placebo treatment. He concluded that acupuncture works to some degree in about 60% of patients with chronic pain, that the effects of acupuncture are greater than those of random needling or placebo treatment, and that acupuncture is as effective for musculoskeletal pain as other treatments such as physiotherapy or drugs. Lewith (50) noted that acupuncture causes fewer adverse reactions than the use of opioid analgesics and anti-inflammatory medications. Richardson and Vincent (54) found good evidence from controlled studies that acupuncture can provide effective short-term pain relief; the figures for effective relief range from 50 to 80% for both acute and chronic conditions. Long-range follow-up data are lacking, however, so little evidence has been found for the long-range benefits of acupuncture. Despite their positive broad conclusions, Richardson and Vincent (54) cautioned that the "placebogenic" qualities of acupuncture treatment might be greater than those of placebo treatments matched to drugs: acupuncture in some cases might simply function as a more effective placebo than its so-called placebo control.

Overall, given the above reviews, acupuncture appears to have positive therapeutic benefit, but it falls far short of the claims of its zealous advocates who believe it to be uniquely powerful. How important is the lack of a rigorous scientific data base? Most therapies in modern medicine, including many common surgical procedures, would appear weak if evaluated rigorously on the basis of the supporting literature—most medical practice is not derived from a systematic program of scientific research. Much has been demanded of acupuncture because it is basically a folk medicine and because strong claims have been made by its advocates.

B. ACUPUNCTURE AS TRIGGER POINT THERAPY

This part of the chapter introduces a Western approach to acupuncture that illustrates how acupunctural procedures can be employed in conventional medicine. It is derived from my extensive clinical experience with treatment of musculoskeletal pain. The therapeutic techniques introduced follow from my theory about the origins of chronic musculoskeletal pain, which is that such pain, when chronic, often results from peripheral neuropathy secondary to age-related degenerative changes or former injuries. Many problems seemingly localized to specific body areas are postulated to originate in subtle spondylotic radiculopathy. My therapy for such problems targets chronic skeletal muscle contracture and is thought to work primarily through somatic and sympathetic spinal reflexes. This theory is not the only conceivable basis for performing acupuncture in Western medicine, but it provides a clear and practical demonstration of how the principles of ancient Chinese medicine and contemporary medicine can be reconciled.

Origin of Musculoskeletal Pain

Musculoskeletal pain that often arises and persists indefinitely in the absence of a detectable permanent injury or inflammation is the most common type of chronic pain; fortunately, it is also the most amenable to trigger point therapy. This type of pain is poorly understood, difficult to diagnose, and rarely treated successfully by other interventions. Muscle contracture is a fundamental component of such pain. When a nerve is injured or irritated, pain persists beyond healing only if the nerve has had pre-existing chronic damage (56). Spondylotic radiculopathy can be a cause of chronic nerve damage and a little-acknowledged source of musculoskeletal pain (13, 57).

Radiculopathy can cause pain by any of three possible mechanisms: (a) it can result in disuse supersensitivity in nerves and muscles and cause them to generate anomalous impulses that then proceed along conventional pathways to evoke abnormal sensorimotor activity, which can include pain (58–60); (b) muscle contractures can occur and cause pain by squeezing intramuscular nociceptors—when paraspinal contractures compress nerve roots, they can create a vicious circle of pain; (c) sustained contractures can lead to degeneration and secondary pain at activity-stressed parts of the body already weakened by radiculopathy-induced collagen degradation (61). According to this model, conditions such as tendinitis, epicondylitis, spondylosis, discogenic disease, and osteoarthritis are conventionally regarded as primary conditions but are sometimes secondary to a neuropathic process in which muscle contracture is a critical factor. This postulate is difficult to prove, but it provides a useful working hypothesis for patient examination and therapy.

Table 90-1. Some Clinical Manifestations of Radiculopathy*

Affected Area	Manifestations
Dermatome	Vasomotor: skin is cooler, mottling; sudomotor: increased sweating; pilomotor: goose bumps, cutaneous hyperesthesia; trophedema or neurogenic edema, alteration in texture of skin and subcutaneous tissue; trophic changes in skin and nails, hair loss
Myotome	Myalgic hyperalgesia, tenderness over motor points; increased muscle tone, spasm (and reduced joint ranges)
Sclerotome	Periosteal and joint tenderness, swelling and effusion; enthesopathy (thickening in tendons attached to joints)

*Neuropathy can cause sensory, motor, or autonomic dysfunctions, or a combination of these, in the corresponding dermatome, myotome, and sclerotome. These areas do not necessarily coincide spatially, and the resulting multiphasic picture can be confusing.

Diagnosis

The varied presentations of acute pain and the gradual onset of radiculopathic pain can be confusing. When pain is produced by acute trauma or by a rapidly expanding space-occupying lesion, some degree of denervation is usually present; onset and diagnosis are therefore usually clear-cut (e.g., herniated intervertebral disk). Spondylotic radiculopathy generally follows a gradual, relapsing, and remitting course, however, which is silent unless pain is precipitated by an accident (often so minor that it can pass unnoticed by the patient). Because symptoms and signs of subtle neuropathy (as distinct from those of denervation) are less well known, the diagnosis is frequently missed, and involvement of the nerve root might not even be suspected (62) (Table 90-1). The origin of the pain is still more baffling when it is not the radiculopathic pain per se that manifests itself but secondary pain caused by neuropathy-related muscle shortening or contractures. For example, segmental pain from the cervical spine referred to the elbow is almost always diagnosed as "lateral epicondylitis" or "tennis elbow" and is commonly taken for a local condition (63) (Fig. 90-3).

The causes of subtle peripheral neuropathy are as many as those of nerve damage (e.g., neoplasm, toxicity, trauma, inflammation, infections). However, because the pathology of neuropathy is limited to axonal degeneration and segmental demyelination (with variable degrees of damage and reversibility), clinical manifestations are relatively few. These might or might not include pain: some neuropathies are asymptomatic, because pain occurs only when nociceptive pathways are involved (e.g., Raynaud's phenomenon, idiopathic hyperhidrosis) (64, 65).

The clinical manifestations of radiculopathy—mixed sensorimotor and autonomic disturbances—are diffuse and usually symmetric; even when symptoms are unilateral, latent signs are generally noted on the contralateral side. This observation is contrary to conventional neurologic principles. Autonomic nerves are involved in the overall pattern of neuropathy and can contribute to these peculiar pain patterns through

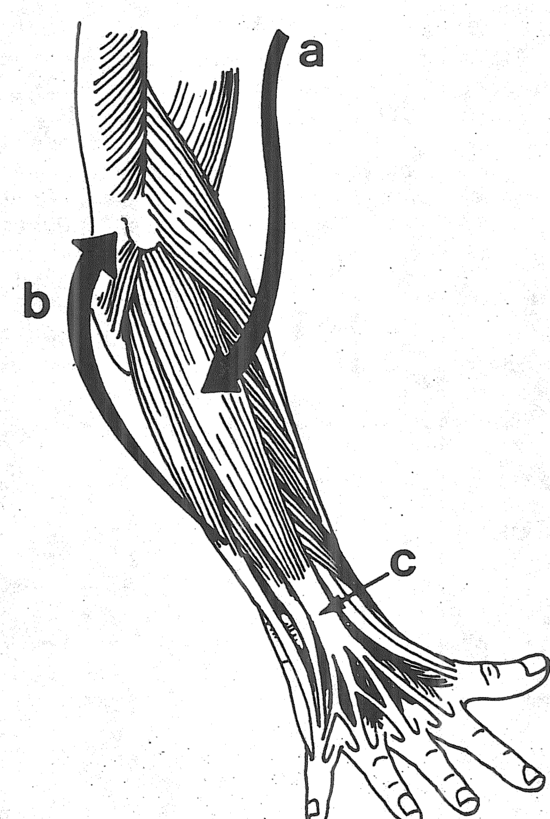

Fig. 90-3. Tennis elbow as seen from the viewpoint of spondylotic radiculopathy: (a) tenderness over a motor point; (b) pain and tenderness in lateral epicondyle; (c) contracture of the tendon of the extensor digitorum communis.

several mechanisms. Vasomotor, sudomotor, and pilomotor changes are commonly seen, and vasoconstriction gives neuropathic pain a cardinal feature that differentiates it from inflammatory pain—affected parts are perceptibly colder.

Laboratory, radiologic, and other tests are usually unhelpful. Radiologic findings only demonstrate late, secondary changes in joints. Routine electrodiagnostic tests are also unrevealing; nerve conduction velocities usually remain within normal ranges but F-wave latencies can be prolonged. Electromyography might only show increased and prolonged insertion activity (Chapter 35).

Although diagnosis depends almost entirely on the examiner's acumen and experience, the characteristic patterns of myofascial disorders are soon appreciated. Many syndromes are now clinically recognized although they are considered to be local conditions (Table 90-1). Because pain is primarily related to muscle, however, signs in muscles are the most consistent and relevant; these include increased muscle tone (62), tenderness over motor points (66), and tender, palpable contractures, which lead to restricted joint range (66, 67). In radiculopathy, signs are present in the territories of both primary rami. It is common knowledge that sciatic leg pain originates from the low back and the latter is always examined, but it is less well known that many other musculoskeletal pain syndromes also originate from the spine. Therefore, when pain presents in structures supplied by the anterior primary division of the spinal nerve (e.g., pain in the elbow or shoulder), structures supplied by the posterior primary division (i.e., the neck) must also be examined.

Once signs of neuropathy have been found, a knowledge of the nerve supply origins of muscles helps to identify the segmental nature of the pain and the levels of spinal involvement. For example, in chondromalacia patellae, crepitus and pain might be focused under the patella and in the knee, but careful examination reveals signs of radiculopathy (e.g., tenderness over muscle motor points and painful contractures) in the muscles that extend the knee through the patella (the quadriceps femoris muscles, L2–L4). Signs in the paraspinal muscles at the same levels then confirm the segmental levels of radiculopathy (66). Each muscle must be palpated. Because many deep paraspinal muscles explored by needling for contractures extend throughout most of the length of the spine (e.g., the longissimus), the entire spine must be examined even when symptoms are localized to one region (67). For example, low back pain is most common at the L5 to S1 levels but higher segmental levels are involved more often than not, frequently reaching lower dorsal levels.

General Principles of Treatment and Technical Considerations

Treatment for radiculopathic pain depends on the degree and reversibility of radiculopathy. Because these can vary considerably, the variety of treatment methods is extensive. Treatment goals are release of contractures, promotion of healing, and removal of the source of irritation. Most injuries to nerves are minor, and the neuropathy is minimal and transient. Pain therefore resolves spontaneously with time and the temporary relief of pain (e.g., with analgesics or the application of simple physical therapies such as heat or massage) might be all that is necessary while the nerve heals (usually within days or, at the most, weeks). When such measures fail treatment might require more effective therapies.

Musculoskeletal pain of radiculopathic origin is usually accompanied by contractures, and pain is usually relieved when these contractures are released. This suggests that contractures are an inherent component of this type of pain and that their release forms an important part of treatment. When simple methods fail to release contractures, more effective methods, such as stretching contractures and cooling them with fluorimethane sprays (12), intense focal pressure over acupuncture points (acupressure), or transcutaneous neural stimulation, can prove effective. When painful contractures do not respond to such measures, injection methods might be useful. Local anesthetics are commonly employed, but normal physiologic saline solution has also been used with good results (13) (Chapter 21). Benefits of injection methods are that they temporarily eliminate the primary focus of intense nociceptive input into the neuraxis and eliminate the secondary focus from local inflammation created by the needle. Dry-needle stimulation alters the trigger point and produces inflammation, and thus is also effective.

Physical therapies probably relieve neuropathic pain by reflex stimulation of the deprived (and supersensitive) muscle through its nerve (Chapter 23), but such stimulation is ordinarily brief. By contrast, dry needling or acupuncture can produce prolonged stimulation through the generation of a current of injury that lasts for days (67). Needle therapy might also have a unique beneficial feature; it is speculated that it promotes healing by the local release of the platelet-derived growth factor (68).

Theoretically, sustained shortening in paraspinal muscles acting across an intervertebral disk space can increase pressure on facet joints (i.e., facet-joint syndrome) as well as compress the disk, contributing to its eventual loss of height and to narrowing of the intervertebral foramina. Paraspinal contractures can thus irritate nerve roots indirectly (e.g., through pressure of a bulging disk) and cause radiculopathic manifestations that present some distance away in the territory of the neurotome. A vicious circle can arise and perpetuate segmental pain: pressure on a nerve root → radiculopathy → pain and contractures → further compression of the nerve root. Treatment of this predicament by the release of paraspinal muscle spasm is therefore indicated.

Selection of Points

Treatment sites are chosen on a neurophysiologic basis and in accordance with the segmental level of injury. The most effective sites for releasing contractures are at muscle motor points and musculotendinous junctions; these generally correspond to traditional acupuncture points (69, 70). A motor point is the skin region at which an innervated muscle is most accessible to percutaneous electric excitation at the lowest intensity. This point generally overlies the muscle motor band of innervation. Points belonging to the affected myotome(s) are chosen for treatment. For example, in treating an injury between the L3 and L4 vertebrae affecting the L4 nerve root, points in muscles belonging to the L4 myotome would be treated. Emphasis is placed on muscles that show palpable spasm and myalgic hyperalgesia (Chapter 21).

Location of Treatment Sites

The exact location of a motor point can vary slightly from patient to patient, but the relative position follows a fairly fixed pattern. Musculotendinous junctions are easily located by palpation and can be thickened (enthesopathic) in chronic musculoskeletal pain.

Recently an electric point finder, the neurometer, has been adopted by some for motor point location. The principle of the neurometer is similar to that of a standard calibration-stable stimulator with variable output control used to evoke muscle twitches in response to minimal electric stimulation. During stimulation the skin over motor points has the least resistance to the current because terminal branches of the muscle nerve there lie closest to the skin; a muscle twitch is produced with completion (or breaking) of the electric current between the electrodes by the patient's body.

The neurometer is powered by dry cells, generally 9 to 21 V (58), and consists of a milliammeter with a probe and ground or indifferent electrode. The indifferent electrode is held in the hand of the patient while the probe explores the body surface for areas where resistance to direct current is lowest. When the probe contacts such a point, the neurometer emits an audible signal and the milliammeter shows a reading. Unlike the standard calibration-stable stimulator, with visible muscle contraction as the indicator, the neurometer is not specific; it indicates a skin point that has low electric resistance, but not all such points are necessarily over motor bands. The accuracy of a neurometer has been criticized because skin resistance to direct current can vary according to room humidity, skin temperature, sudomotor activity, voltage, and other factors. In any individual under any given set of conditions, however, there is a definite relative difference in skin resistance over a motor point as compared with surrounding skin (69).

I do not use the neurometer because motor bands are known anatomic entities at fixed anatomic sites that vary only slightly from one person to another. Moreover, bands that require attention are frequently palpable or tender and thus are easily found. Charts showing the distribution of motor points are available. The earliest was prepared by the neurologist Wilhelm Erb in 1882, and anatomic guides for the electromyographer are available. A comparison of a traditional acupuncture chart with a chart of motor points shows many similarities (16).

Contracture Release by Electric Stimulation

A low-intensity current can be used to promote release of contractures involved in chronic pain syndromes. Electric stimulation can be in the form of a low-voltage (9 V) interrupted direct current administered for a few seconds to each inserted needle with a neurometer point-finder probe, or a phasic current can be applied through pairs of electrode leads to inserted needles for approximately 15 minutes. Visible muscle contractions usually indicate proper needle placement. Release of contractures occurs best when the stimulation frequency allows the muscle to relax between contractions and not summate to produce tetanic contraction. The summation frequency (about 30 to 100 Hz) varies from muscle to muscle—for example, that of the soleus, at about 30 Hz/s, is much lower than that of the tibialis anterior. Electric stimulation has little advantage over mechanical agitation when the needle has been accurately placed.

When the several most painful contractures in a muscle have been needled, the entire muscle relaxes within minutes and, when the several most painful muscles in a painful region have been treated, pain is relieved in the treated region. Muscle relaxation and pain relief in one region can spread to the contralateral side, to paraspinal muscles, and to the entire segment. These considerations suggest a reflex neural mechanism that might involve spinal modulatory systems.

Relaxation also involves smooth muscle, and it can spread to the entire segment, thus releasing vasospasm and constriction of lymphatics (71). The sympatholytic effect improves blood flow to the painful part and encourages lymph drainage. Painful joints can be treated by releasing contractures in all the muscles acting on the joint. This can be followed by subjective pain relief, sometimes within minutes, and confirmed by objective improvement in the range of motion of the joint.

Treatment of Fibrotic Contractures

It is theoretically possible for contractures to become chronic, eventually fibrotic, and painful (fibrositis or fibromyositis). When fibrosis has become a feature of contractures, response to treatment is modest. Treatment of extensively fibrotic contractures necessitates more frequent and extensive needling because part of the muscle shortening is maintained by fibrosis rather than by contracture. Release is often limited only to the individual muscle bands that are specifically treated—to relieve pain in such a muscle, all tender bands require needling. This implies more needle insertions per session, or more sessions with the same number of insertions. For significant, long-lasting pain relief and restoration of function, several treatments separated by days are usually necessary (72).

The progressive nature of symptomatic relief, substantiated by the gradual amelioration of objective clinical findings, suggests that a healing process is involved. The condition can be considered to be reversed when symptoms and signs are eliminated and do not recur. Acupuncture therefore does not relieve pain primarily by analgesia as it is traditionally defined (e.g., in a normal nervous system subjected to noxious afferent input) but rather by moderation of the manifestations of a neuropathic, supersensitive nervous system (e.g., releasing painful muscle contracture and vasoconstriction). Unlike other physical remedies, acupuncture may well promote healing.

Treatment of Specific Problems

The following are general guidelines for treating some common pain syndromes. In practice the sites for treatment are found by palpating muscle for tight contracture bands. Charts of points can be useful, but they do not indicate the depth that the needle has to penetrate.

Headache

Headaches of intracranial origin are rare (e.g., space-occupying tumors, cerebral hemorrhage, hypertension) but have to be excluded (Chapter 39). Acupuncture is effective in treating the following: (a) headaches of musculoskeletal origin related to muscular contraction occurring about the head and neck—these are usually secondary to cervical spondylosis and are probably the most common form of headache; and (b) headaches of vascular origin (e.g., migraine and cluster headaches; Chapter 39).

Commonly used points are in the head, neck, and upper shoulders. Points in the neck and upper shoulders are treated initially, and this can provide relief. Points in the head and hand can be added in later sessions if the pain persists. These include the following muscles:

In the head. Temporalis, corrugator supercilii, frontalis, masseter, levator labii superioris

In the neck. Splenius capitis and cervicis, semispinalis capitis, scalenus anterior, medius, and posterior, sternomastoid (Fig. 90-4).

In the shoulder. The upper trapezius is probably the most effective point for headache (but extreme care should be taken to avoid penetrating the lung), supraspinatus, infraspinatus, levator scapulae.

In the hand. The motor point of the first dorsal interosseous muscle between the thumb and index finger is a popular traditional point (known as the *ho-ku*) that is effective for headache and pain in the upper extremity. This small muscle might seem trivial, but it has the highest concentration of muscle spindles in the body and the hand has a large representation in both motor and sensory areas of the cerebral cortex.

Neck Pain (Including "Whiplash") and Upper Extremity Pain

Pain from the cervical spine is discussed together with pain in the upper extremity because the upper limb, having been derived in the developing human embryo from the upper extremity bud, is effectually an extension of the neck. Tender muscle points seldom occur in one part without being present in the other, and frequently both must be treated.

For treatment purposes, neck pain is discussed as upper, middle, and lower cervical spine pain:

Upper cervical spondylosis. Pain in C1, C2, and C3 often presents as occipital headache affecting muscles that insert at the occiput, or as pain in the neck muscles. Sometimes pain is referred to the jaw.

Middle cervical spondylosis. Pain in C4, C5, and C6 can present as headache, neck ache, or, commonly, as pain in the shoulder and upper arm.

Lower cervical spondylosis. Pain in C7, C8, and T1 can present as headache or neck ache but, more frequently, occurs as pain in the elbow (lateral epicondylitis, C6 and C7), wrist, and hand (C7, C8, T1). It is not unusual for pain to occur in the arm without apparent neck involvement. For example, in carpal tunnel syndrome, the symptoms are generally confined to the hand, but examination of the forearm and neck almost always discloses spasm and tenderness in the wrist flexors and extensors and in the paraspinal muscles of the same segments.

Acupuncture treatment of these conditions is generally effective for pain relief and function can be largely restored, but late changes following denervation, such as muscle wasting, are irreversible. Even surgical release of a carpal tunnel compression cannot reverse such changes. Treatment points are located in the neck, shoulder, elbow, and wrist:

Treatment points in the neck. The superficial neck muscles mentioned above for headache are used as well as deep paraspinal muscles at affected spinal levels: semispinalis capitis, semispinalis cervicis, spinalis cervicis, and multifidus.

Treatment points in the shoulder. The location of symptoms and therefore the primary points for treatment in the shoulder and arm depend on the spinal level(s) affected by spondylosis. Generally, more than one segmental level is affected.

For C3 and C4 the scapula is pulled upward by contractures in the trapezius and levator scapulae muscles. For C4 to C6 pain can occur during the initiation of abduction, primarily involving the rotator cuff muscles (i.e., rotator cuff tendinitis): the supraspinatus, infraspinatus, teres minor, and subscapularis, but the latter is not easily accessed for treatment. Pain and limitation of the first 60° of abduction (pain arc) can be present when the deltoid muscle (C5, C6) is involved. (Pain and tenderness at the mid-deltoid motor point is commonly labeled as bursitis. The scapula can be pulled medially by the rhomboideus major and minor (C5). Pain and limitation of forward extension and abduction are usually associated with limitation of the glenohumoral range caused by spasm in the infraspinatus (C4–C6) and teres muscles (C5–C7).

For C7 and C8 pain and limitation of internal posterior rotation is primarily associated with spasm in the pectoralis major (C7, C8) and pectoralis minor (C8, T1).

Occasionally spondylosis affects several levels and almost every muscle that activates the shoulder (C3–C8) is implicated to a greater or lesser degree. A "frozen shoulder" occurs when there are contractures in all the muscles that act on the shoulder. This condition, which usually resists all other physical measures, responds well to acupuncture.

Acromioclavicular joint pain usually responds to treatment of the pectoralis major (clavicular head), anterior deltoid, and upper trapezius muscles.

Treatment points in the elbow and wrist. Pain occurs more commonly on the lateral aspect of the elbow (lateral epicondylitis or tennis elbow), where the following muscles must be treated: biceps, brachialis, brachioradialis (C5, C6), extensor carpi radialis longus and

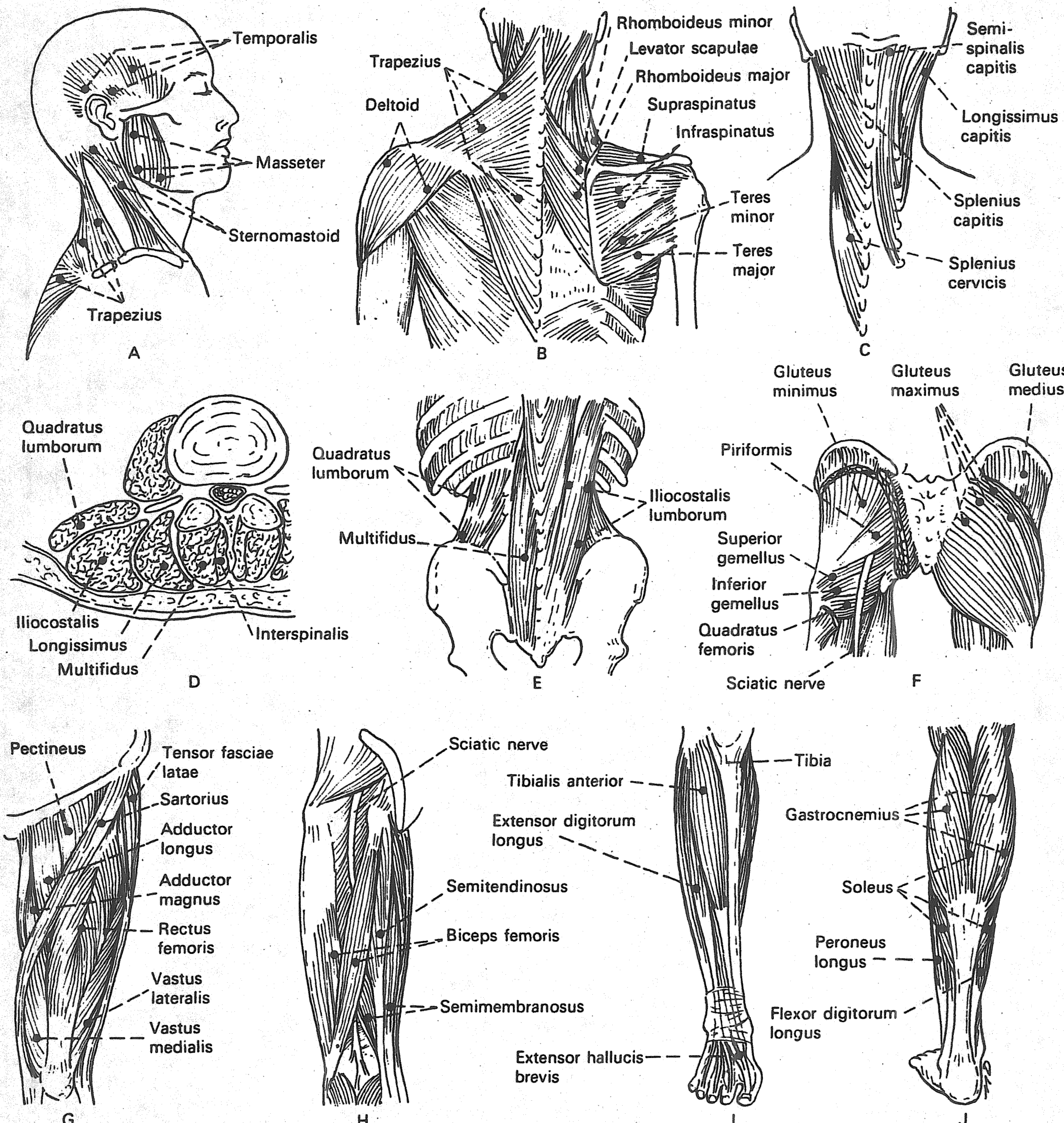

Fig. 90-4. Commonly used trigger points in various parts of the body.

brevis, anconeus, extensor digitorum, extensor carpi ulnaris (C6, C7), and supinator (C6). When pain is on the medial aspect of the elbow (golfer's elbow), the following muscles are treated: pronator teres, flexor carpi radialis and ulnaris, and triceps (C6–C8). The palmaris longus is the prime muscle treated in early Dupuytren's contracture (C7, C8).

For pain in the wrist, the above two groups of muscles are treated. For carpal tunnel syndrome, the thenar muscles (supplied by the median nerve) are added.

Low Back Pain and Lower Extremity Pain

Just as the neck and upper extremity must be considered together, the leg is considered to be an extension of the lumbar back, having been derived in the developing human embryo from the lower extremity bud. As in neck and upper limb pain, the therapy of low back pain and leg pain is usually a single process. When pain is of purely musculoskeletal origin, response to this treatment can be rewarding. Early discogenic pain is included in this category because spasm in the deep paravertebral muscles can cause strong compression of the disk. Unless impingement of the nerve root by irreversible structural changes is present, which is rare, the release of the muscles can provide relief and surgery can be avoided. Patients with discogenic disease proven by myelography and EMG studies have responded to this treatment with no recurrence of pain after several years' follow-up.

Examination of the lumbar back must go beyond the standard examination for signs of denervation (e.g., straight leg raising, Lasègue's test, attenuated reflexes, sensation loss, muscle wasting). In most back pain patients with early neuropathy, these signs are generally negative and the examiner must search for more subtle signs (e.g., trophedema, tenderness at motor points, increased muscle tone, autonomic signs). Careful examination for these signs demonstrates that, even if symptoms appear to be at one level, several segmental levels are usually involved. The key to successful treatment of persistent low back pain of musculoskeletal origin is that the entire lumbar back (often as high as lower dorsal levels) must be treated as well as the lower extremities (which might not necessarily be in pain). Treatment points are located in the lumbar back, buttock, thigh, hamstrings, calf, and anterior leg:

Treatment points in the lumbar back. Treatment points in the lower back include the quadratus lumborum, erector spinae, iliocostalis lumborum, iliocostalis thoracis, longissimus, and multifidus muscles (all lumbar segments). When the needle is inserted it serves as a useful and unique diagnostic tool for revealing the presence of any deep muscle spasm.

Treatment points in the buttock. Treatment points in the buttock include the gluteus maximus (L5, S1, S2), medius, and minimus (L4–S1); sometimes diagnosed as hip bursitis, superior (L5–S2) and inferior gemellus (L4–S1), piriformis (S1, S2; piriformis syndrome), and quadratus femoris (L4–S1) muscles. These points, especially in the glutei muscles, should be treated with a needle at least 3 inches long.

Treatment points in the thigh. Treatment points in the thigh include the rectus femoris, vastus lateralis, medialis, and intermedius, and tensor fascia latae (trochanteric bursitis). These points are needled particularly when pain originates from L2 to L4 segments. They are also the points to be used for knee pain. It can be most rewarding, in one session of treatment, to return full extension to the knee when an extension lag has resisted all forms of physical therapy. When pain is on the medial aspect of the knee the semimembranosus, semitendinosus, gracilis, and sartorius (pes anserinus) are treated. Even when mild effusion from a minor meniscus tear is present, but without the knee locking, the condition can be treated.

Treatment points on the medial aspect of the thigh. The adductor muscles, magnus, longus, and brevis (L3–L5), are treated when there is limitation of hip *F*lexion, *ab*duction, and *e*xtension and *r*otation (i.e., when the Faber test is positive).

Treatment points in the hamstring. Treatment points in the hamstrings include the semimembranosus, semitendinosus (L5–S1), and biceps femoris (L5–S2). These muscles are almost always involved in low back pain. Limitation of straight leg raising can often improve dramatically following treatment of these muscles.

Treatment points in the calf. Treatment points in the calf include the tibialis posterior (L5–S1), gastrocnemius, and soleus (L5–S2). These muscles are always involved in low back pain. Because they provide the major force in supporting the longitudinal arch of the foot, they are important points for pain in the heel and sole of the foot. For "metatarsalgia" the flexor digitorum in the sole is also needled.

Treatment points on the anterior leg. Two important muscles are used as treatment points on the anterior leg, the tibialis anterior (L4, L5) and extensor digitorum longus (L4, L5, S1). Treatment of these can relieve shin splints and pain in the ankle. When the extensor hallucis longus and brevis muscles are also needled, early hallux vulgus and bunion of the big toe can be corrected.

Autonomic Dysfunction

The autonomic nervous system is a division of the peripheral nervous system that is distributed to smooth muscles and glands throughout the body. It is entirely an efferent system, and it is vegetative in the sense that most of its functions are carried out below consciousness. It is, however, highly integrated in function with the rest of the nervous system. By treating striated muscles belonging to the same segments, the acupuncturist can treat spasm in smooth muscles and hyperactive glands that are inaccessible to needling. Some common conditions that respond to treatment are the following:

Vasomotor hyperactivity. When pain is associated with increased sympathetic activity (sympathetic maintained pain syndromes, such as Raynaud's disease and causalgia), it can be treated as for upper or lower limb pain, as appropriate.

Sudomotor hyperactivity. This can be treated as for upper or lower limb pain, as appropriate (e.g., idiopathic hyperhidrosis).

Smooth muscle spasm. Treatable conditions include asthma (trapezius and accessory muscles of respiration, paraspinal muscles in the dorsal back), visceral pain, colic, such as biliary (T5–T8), intestinal (T10–T12), and vermicular (T12–L5) (traditional acupuncture favors the points on the front of the leg, and the tibialis anterior motor point is known as "stomach 36"), and dysmenorrhea (L5–S2).

Glandular hyperactivity. Pain of gastric and peptic origin responds to treatment of paraspinal muscles (T5–T12).

C. SUMMARY AND CONCLUSIONS

More than a decade after its introduction on a large scale in the West, acupuncture remains a mystery and a point of controversy. It seems clear from the results of animal, human laboratory, and clinical studies that acupunctural stimulation (particularly electric stimulation) can alter pain perception and relieve pains of clinical origin. The human laboratory and clinical studies are consistent, however, in showing that acupunctural stimulation offers no panacea. The effects seen are inevitably modest when large groups of subjects or patients are examined, and the collective outcomes of the last decade clearly fail to support the exaggerated claims of many of the advocates of acupuncture made in the early 1970s. When the overlap of acupunctural therapy with trigger point treatment and electric stimulation therapy is considered, it becomes questionable whether acupuncture merits its own identity as a therapeutic procedure in Western medical practice and research. This situation suggests a pragmatic solution to the question of how acupuncture should be regarded by the physician concerned with pain management. The following three principles are offered as guidelines.

First, acupuncture should be addressed, considered, and scientifically investigated as a method for hyperstimulation therapy, as advocated by Melzack and Wall (47) or, more specifically, as a treatment for conditions of neural degeneration or neuropathy (as proposed here) and not as a form of Chinese medicine. The practice of classical Chinese medicine is without a scientific foundation in Western medical practice, but acupunctural techniques can be beneficially employed for the practice of electric stimulation therapy or trigger point therapy, or for both. Viewed in this framework, such techniques draw on a scientific rationale and on clinical data bases in two or more areas. Acupuncture techniques, stripped of their mystique, offer a safe and inexpensive therapeutic alternative to writing prescriptions. They need to be regarded as an alternative form of medicine only when practiced by nonphysicians.

Practitioners interested in acupuncture therapy should broaden their focus to include TENS and trigger point therapy. TENS is more expensive than acupuncture for the patient because a TENS unit needs to be purchased, but control over the therapy is largely in the hands of the patient rather than the doctor. Trigger point therapy differs little from acupuncture when a dry needle technique or saline injection is used, and it is slightly more expensive than acupuncture because it involves needles that cannot be reused. Because the tips of acupuncture needles are not beveled like those of injection needles, acupuncture is less traumatic to tissue, causes less minor bleeding, and is somewhat less painful.

Second, the possibility that acupunctural stimulation might be related to an alteration of endorphin levels should be de-emphasized in discussing such methods with patients and in considering whether a therapeutic trial with acupuncture is indicated for a given patient. The animal literature clearly shows an association of acupunctural stimulation to endorphins, but advocates of acupuncture appear to be confusing stress-induced analgesia in animals with the (hopefully) stress-reducing therapy performed in a physician's office. The link of endorphin levels to chronic pain states is as yet uncertain and controversial, and it is not known whether any long-term benefit of treatment would accrue to a patient with chronic pain even if acupuncture treatment resulted in endorphin release for a short period of time. Future findings could have a great impact on this conclusion.

Third, despite the problems and limitations of the clinical literature, it is clear that acupuncture offers little hope for a "miracle" cure for chronic pain problems. It is appropriate to advise patients that controlled outcome studies, although favorable, show limited and modest positive benefit of treatment overall and that insufficient information has been obtained to determine whether positive gains are lasting when pain is chronic. The literature does support claims that acupuncture is a low-risk treatment when properly performed; the cost of such treatment can be of greater concern to patients than safety. Physicians should be alert to the possible suppression of important symptoms of disease when patients undergo acupuncture therapy for pain.

It is most unfortunate that, after a decade of research in this area, the literature does not permit firm conclusions to be reached about therapeutic efficacy that could be summarized in a book such as this for clinical referral guidelines. It seems clear that classically performed acupuncture remains an experimental therapy. The clinical problems for which it is and is not appropriate have only begun to be defined. It is unsettling that no consensus has emerged in regard to how acupuncture should be practiced, who are fitting patients, and how many treatments are needed. The old truism remains, however: the absence of evidence is not equivalent to the evidence of absence. Broadly speaking, acupuncture appears to help patients suffering with chronic pain and to do so at a rate greater than that of control treatments. Care must be taken when patients engage the services of nonphysician acupuncturists because symptoms of clinically significant disease might not be brought to proper medical attention. When properly practiced, acupuncture is quite safe, and it offers an alternative to the conventional, often ineffectual, prescription of analgesic medication for patients with persisting pain.

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