CHAPTER 14

Acupuncture, Acupressure, Shiatsu, and Related Therapies

Chapter Summary

After decades of neglect, modern medical researchers and other academic scientists have begun serious and very revealing studies of the acupuncture meridian systems and points and the ways they relate to various structures, functions, and pathophysiologies. A growing number of physicians are adding acupuncture to their clinical practices. Enough new work has been done that a thorough review would fill a book much larger than this one. This chapter presents some highlights and directs the interested reader to some sources of recent information. The current status of acupuncture research will emerge from a look at the work of the following investigators and their colleagues: Helene Langevin, Steven and Donna Finando, Stanley Rosenberg, Joie P. Jones, and Kwang-Sup Soh (Figure 14.1).

An understanding of acupuncture theory and practice has become a major topic for a wide range of therapeutic approaches far beyond acupuncture (e.g., Micozzi, 2010) and is also important for the growing number of people who wish to use the methods on themselves and others to maintain health and vitality. Centuries of clinical experience have shown that acupuncture points, or acupoints, can be stimulated by needling, herbs, pressure, light (including laser light), or heat to resolve clinical problems. For a long time, there appeared to be no anatomical basis for meridians, and this made acupuncture an easy target for skeptics. Others tried to fit the meridians with known structures such as nerves, muscles, or lymphatic vessels. This situation has changed dramatically. Acupuncture research is pointing toward the connective tissue and fascia as the location of the meridians. The research of Joie P. Jones and colleagues, using sophisticated techniques including functional magnetic resonance imaging (fMRI) and quantitative ultrasonic imaging, has developed three-dimensional images of acupoints. They have also followed the day-to-day migrations of the points and shown how points rotate when needled. This research brings acupuncture into important relationships with virtually all other forms of energy medicine as well as with the various manual therapies. The concepts of the living matrix and the ground regulation system, discussed in Chapters 10 and 11, provide a possible explanation of the systemic effects of Oriental medicine.

Research in Asia has revealed a new and novel circulatory system that also seems to have correspondences with the acupuncture meridians. For many years this was known as the Bonghan system (BHS), named after the North Korean surgeon who discovered it in 1963. In 2010, a group of Korean scholars chose, with good reasons, to give the BHS a new name, the primo vascular system (PVS). A key breakthrough was the discovery of a specific dye, trypan blue, which selectively stains this system, thereby enabling detailed study of its anatomy, histology, physiology, and roles in pathophysiology. The fluid from the ducts has also been analyzed. The discovery of this system is opening up new areas of medical research.

Figure 14.1 (A) Dr. Helene Langevin, Department of Neurology, University of Vermont School of Medicine. Currently Director of the Osher Center for Integrative Medicine at Harvard Medical School and Brigham and Women's Hospital, Boston, MA. (B) Stanley Rosenberg, Stanley Rosenberg Institute, Copenhagen, Denmark. (C) Dr. Joie Pierce Jones (1941–2013), formerly Professor of Radiological Sciences at UC Irvine. (D, E) Donna Finando, M.S. L.Ac., L.M.T, and Steve Finando, Ph.D., L.Ac., practicing acupuncturists at Heights Healthcare, Roslyn Heights, NY. (F) Dr. Kwang-Sup Soh, Seoul National University, Korea, and Editor-in-Chief, *Journal of Acupuncture & Meridian Studies*.

Introduction

Selected Recent Texts on Acupuncture Research

Energy Medicine East and West: A Natural History of Qi (Mayor and Micozzi, 2011)
Acupuncture and the Chakra Energy System: Treating the Cause of Disease (Cross, 2008)
Electroacupuncture: A Practical Manual and Resource (Mayor, 2006)
Quantum Acupuncture (Henry, 2011)
Quantum Shiatsu (Stefanani, 2011)
Acupuncture: Theories and Evidence (Hong, 2013)
Acupuncture Research: Strategies for Establishing an Evidence Base (MacPherson, Hammerschlag, Lewith and Schnyer, 2007)

Recent texts have described advances in acupuncture research (see box). *The Journal of Alternative and Complementary Medicine*, the *Journal of Bodywork and Movement Therapies*, and the various

societies related to acupuncture and Oriental medicine have articles on aspects of acupuncture. A variety of theories on the identity of the meridians have been proposed. Here are a few:

- An early model by Walthard and Tchicaloff (1971) was based on the fact that the skin over a muscle motor point has low resistance to electrical stimulation. Therefore, the acupuncture points might correspond to the relatively fixed patterns of motor lines.
- Yang (2008a,b) suggested that the traditional acupuncture meridians are zones in loose connective tissue containing rich intercellular fluid, enabling them to be passages with lower resistance for diffusion of meridian-signal carriers, that these signal carriers ought to be histamine, and that the meridian biological signal amplifier ought to be mast cells.
- Longhurst (2010) suggested a 'neural hypothesis', in which the clinical influence of acupuncture is transmitted primarily through stimulation of sensory nerves that provide signals to the brain, which processes this information and then causes clinical changes associated with treatment.
- Robert O. Becker suggested that the system of acupuncture points and meridians are solid state structures that serve as input channels for the global direct current perineural system described in Chapters 9 and 11 and Figure 11.13. He regarded the meridians as electrical transmission lines (Reichmanis et al., 1975).
- The fascia acupuncture hypothesis described by Finando and Finando (2011, 2012) and others.
- The Bonghan system (BHS) recently renamed the primo vascular system or PVS.
- The Bonghan-fascia model (Lee and Soh, 2009) revealed by vital staining with Trypan blue, which showed the Bonghan networks within and from the fascial system.

Meridians and Fascia

Two thoughtful essays by Finando and Finando (2011, 2012) present a number of important issues related to acupuncture, meridians, and research. The Finando report is of interest to acupuncturists and to others involved in fascial manipulation. It has implications for osteopaths and chiropractors for whom somato-visceral and viscero-somatic reflexes are important. The following summarizes some of their discussion, along with the evidence supporting the points they raise. The Finandos describe correspondences between the location of meridians and particular lines of fascia (Figure 14.2).

The Finandos' call for a return to the traditional palpation techniques that were eliminated from the trainings to standardize and streamline acupuncture teaching and recent research on point location with ultrasound supports this suggestion. They point out that 'Traditional Chinese Medicine' (TCM) as it is currently referred to by many practitioners and the lay public, and that is the most commonly used acupuncture practice among Western practitioners, represents an acupuncture that is primarily the result of political, social, and economic influences. It is a specific product of the Cultural Revolution rather than the ancient traditions of classical Chinese medicine. Birch and Felt (1999) refer to TCM as 'modern' acupuncture because it is a specific creation of the People's Republic of China, beginning sometime around 1950. TCM was a development of a new political structure that faced a major health crisis and needed healthcare for a massive population. TCM had to be amenable to large classroom training, rather than by traditional apprenticeship, since there was a need for rapid, uniform training. Careful training in palpation was virtually eliminated, diagnoses were connected to Western-defined diseases, and textbooks began to provide treatments for arthritis, gastritis, and other such Western-defined pathologies (Finando and Finando, 2012).

TCM is the most commonly employed approach in acupuncture clinical research. Most of what is known scientifically about the clinical effects of acupuncture is based upon study of TCM, rather than the palpation approaches that are still used by a minority of practitioners. TCM marks a significant movement away from an acupuncture that was based upon careful attention to the body toward the use of a more formulaic approach with charted acupuncture points. 'It has replaced attention to the "terrain" with a prescribed use of the "map"' (Finando and Finando, 2012).

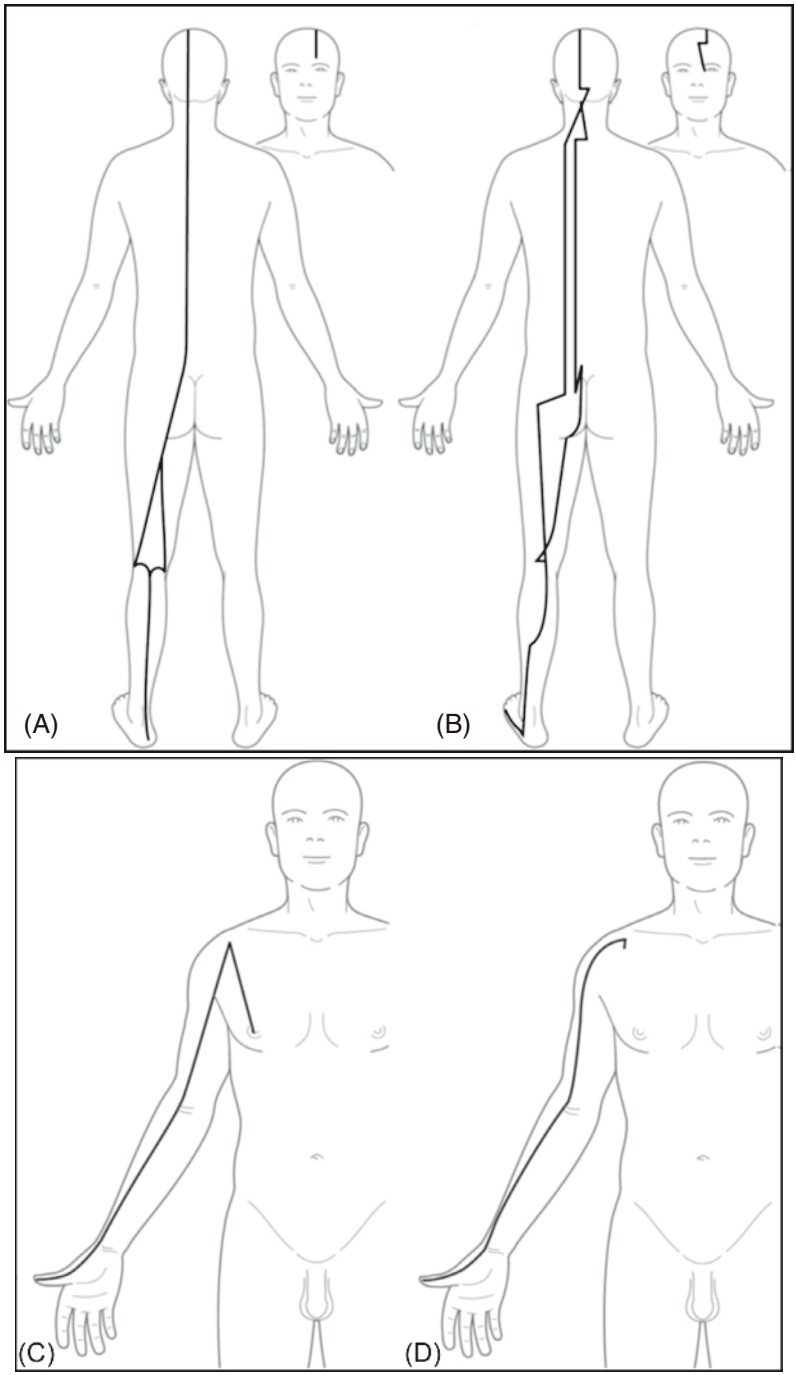

Figure 14.2 Correspondences between the location of meridians and particular lines of fascia based on Finando and Finando (2011, 2012). Left: Comparison of superficial back line (A) and Bladder channel (B). Right: Comparison of deep front arm line (C) and Lung channel (D). *((A) and (C) Redrawn from Myers, T., 2001. Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists. Churchill Livingstone, London; (B) & (D) Redrawn from Finando, S., Finando, D., 2011. Fascia and the mechanism of acupuncture. J. Bodyw. Mov. Ther. 15, 168–176 and Finando, S., Finando, D., 2012. Qi, acupuncture and the fascia: a reconsideration of the fundamental principles of acupuncture. J. Altern. Complement. Med. 18 (9), 880–886.)*

Research supporting a major role of fascia in acupuncture has been done by the investigators and clinicians shown in Figure 14.1.

The Finando (fascia) hypothesis is summarized by three ideas (see box).

The (Fascia) Hypothesis: Summarized by Three Ideas

1. Needle manipulation of the superficial fascia stimulates activity within the fascia.
2. There is extensive anatomical correlation between the classical locations of the acupuncture channels and points with fascial planes and septa.
3. Recent fascia research has demonstrated numerous similarities between the functions of acupuncture channels and the functions of the fascia.

1. Needle manipulation of the superficial fascia stimulates activity within the fascia.

The effects of needle manipulation on superficial fascia were demonstrated by Langevin et al. (2001b). Specifically, acupuncturists commonly notice that the tissue seems to tighten around an inserted needle, particularly when the needle is twisted. This is called 'needle grasp'. Moreover, when the therapist pulls out the needle, it feels like it is stuck, and the skin is lifted. This is called 'tenting' (Langevin et al., 2001a,b). A measurable force is required to pull the needle out. Langevin and colleagues actually measured the force required to pull needles out. They compared unidirectional needle twisting (UNI) with bidirectional twisting (BI) and no twisting (NO), and they also compared acupuncture points with non-points. They found 167% and 52% increases in mean pullout force with UNI and BI, respectively, compared with NO ($P<0.001$). Pullout force was on average 18% greater at acupuncture points than at control points ($P<0.001$). Needle grasp is therefore a measurable biomechanical phenomenon associated with acupuncture needle manipulation and also with acupoints compared to non-points.

Langevin and colleagues also observed that when a needle is rotated, collagen fibres stick to it and become wrapped around it. If the needle is removed and examined under the microscope, strands of collagen are still attached to it. Needle rotation creates tension in the fascial layer that causes fibroblast cells to become deformed. This deformation is thought to trigger metabolic changes in the cells (Chen et al., 1997; Chicurel et al., 1998; Chiquet et al., 2003). Ultrasonic imaging shows spiral deformation, a vortex, in the tissue during needling with rotation. Histology of the same tissue shows the tensional pattern or vortex created by needle rotation.

Julias Edgar Buettner and Schreiber (2008) obtained similar results using collagen gels *in vitro* (Figure 14.3A). The vortical pattern in the gel produced by needle rotation was monitored by cross-polarized optics, which showed the development of birefringence (Figure 14.3B).

2. There is extensive anatomical correlation between the classical locations of the acupuncture channels and points with fascial planes and septa.

Langevin and Yandow (2002) explored the relationship between acupuncture points and meridians and connective tissue planes (Figure 14.4). The illustration shows ultrasound imaging of acupuncture (AP) and control (CP) points. Ultrasound imaging revealed a connective tissue intramuscular cleavage plane at acupuncture points but not at control points. (Langevin and Yandow, 2002).

These imaging studies were confirmed by Stanley Rosenberg, on the basis of palpation, as shown in the box.

> The acupoints feel like depressions that enable me to contact several fascial layers at once. It feels like putting your finger into a cone. Initially there is more tension in the tissue when you try to twist in one direction compared to the opposite direction. After the tissue has released, the resistance to twisting is the same in both directions.
>
> ***Stanley Rosenberg, Copenhagen***

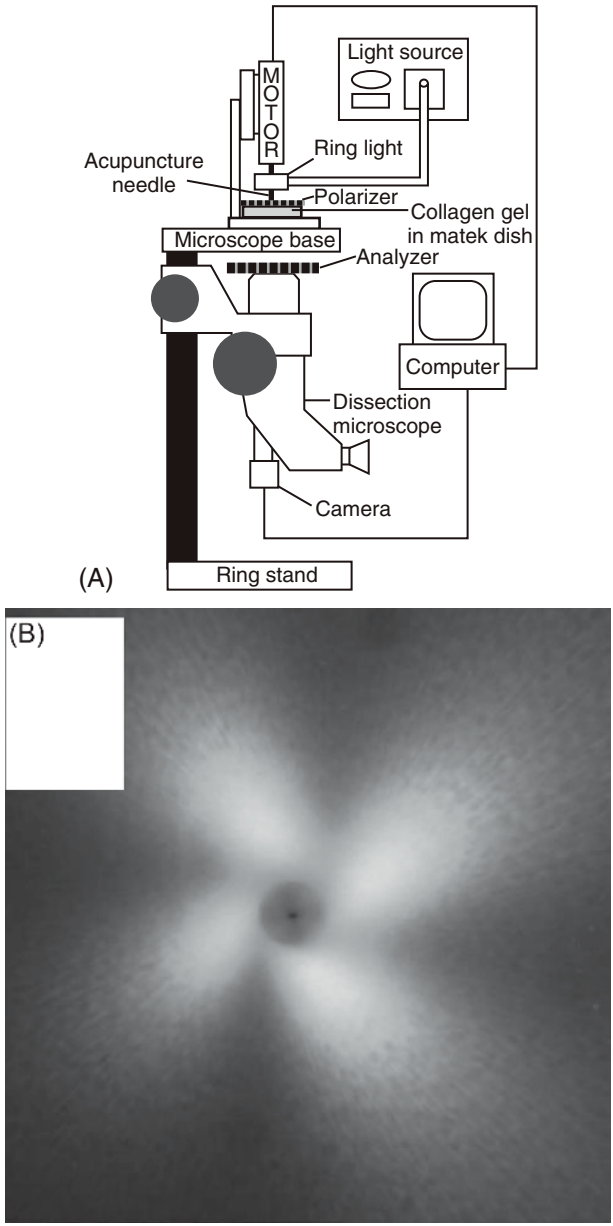

Figure 14.3 (A) Apparatus used to insert and rotate an acupuncture needle in a collagen gel. (B) Polarized light microscope image of a collagen gel showing a characteristic 'four-leaf clover' pattern of birefringence that increases in size as the gel becomes increasingly aligned due to winding around the needle. *(Julias M, Edgar LT, Buettner HM, et al: An in vitro assay of collagen fiber alignment by acupuncture needle rotation, Biomed Eng Online 2008 July 7;7:19.)*

Again, Finando and Finando (2011) illustrated the correspondences between the fascial planes as described by Myers (2001) and specific meridians (the Bladder channel and the Lung channel, Figure 14.2).

3. Recent fascia research has demonstrated numerous similarities between the functions of acupuncture channels and the functions of the fascia.

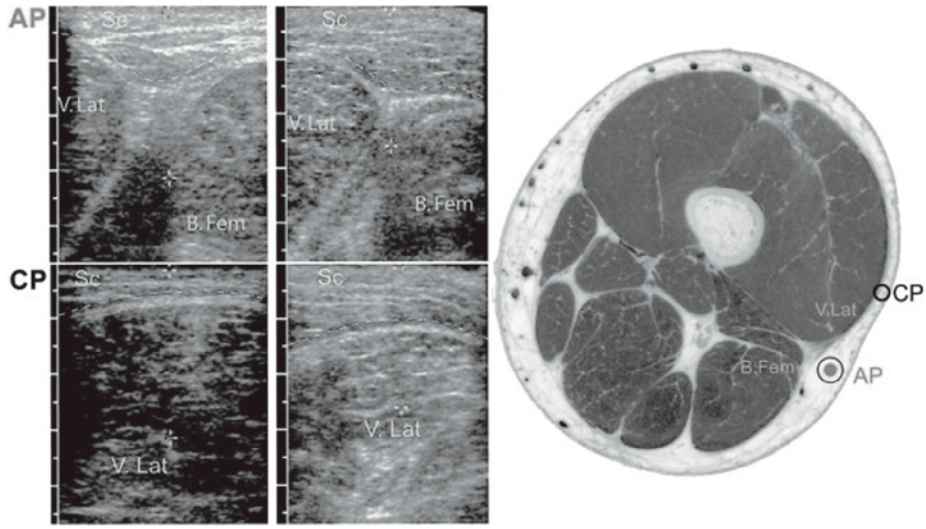

Figure 14.4 Ultrasound imaging of acupuncture (AP) and control (CP) points. Acupuncture point GB32 was located by palpation in two normal human volunteers, as well as a control point located 3 cm away from the acupuncture point. After marking both points with a skin marker, ultrasound imaging was performed with an Acuson ultrasound machine equipped with a 7 MHz linear probe. A visible connective tissue intramuscular cleavage plane can be seen at acupuncture points but not at control points. V. Lat, vastus lateralis; B. Fem, biceps femoris; Sc, subcutaneous tissue *(From Langevin HM, Yandow JA: Relationship of acupuncture points and meridians to connective tissue planes, Anat Rec 2002 Dec 15; 269(6):257–265).*

The fascia and extracellular matrix (ECM) are the environment of every cell, and therefore affect immune function, metabolism, circulation, organ function, and virtually every aspect of human physiology.

> *The extracellular matrix (ECM) is the environment that is most immediate to the human cell. Its functions include nutrient transfer, nerve signal transduction, regulation of intercellular communication, and transmission of mechanical stresses exerted on the cytoskeleton. Oschman (2007) states: 'Every function and every process of the living body involves the matrix in one way or the other. The reason for this is that every cell in the body is nourished via the matrix, and all waste products of cellular metabolism likewise pass through the ground substance, which is the actual milieu. The matrix is also the terrain in which all immune responses and tissue repair processes take place.' The ECM is a fundamental component of the fascia.*
>
> FINANDO AND FINANDO (2012)

Additional work by Langevin et al. (2004) using a combination of histochemistry, immunohistochemistry, confocal scanning laser microscopy (confocal microscopy), and electron microscopy revealed that fibroblasts in subcutaneous and interstitial connective tissues form a reticular web throughout the tissue (Figures 14.5 and 14.6). Connexin 43 immunoreactivity was present at apparent points of cell-to-cell contact. It appears that soft tissue fibroblasts form an extensively interconnected cellular network extending throughout the skin (Figure 14.6B). When you touch the skin in one place, you are, in a sense, touching the whole skin. A similar reticulum occurs in bone (Figure 14.6C).

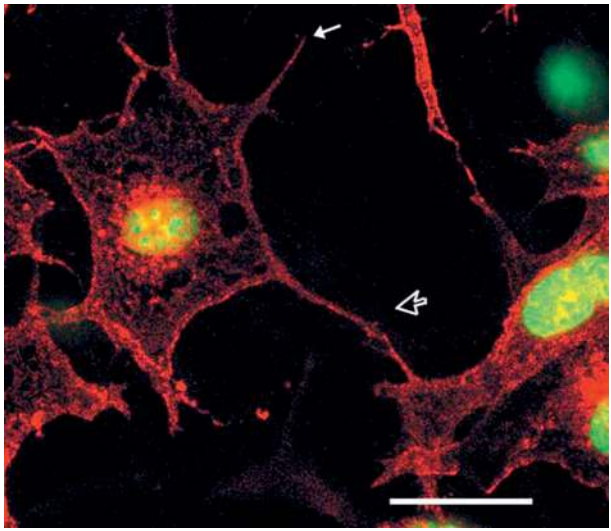

Figure 14.5 Fibroblasts in subcutaneous and interstitial connective tissues form a reticular web throughout the tissue. Connexin 43 immunoreactivity was present at apparent points of cell-to-cell contact (arrows). *(From Langevin, H.M., Cornbrooks, C.J., Taatjes, D.J., 2004. Fibroblasts form a body-wide cellular network, Histochem Cell Biol July 122 (1), 7–15.)*

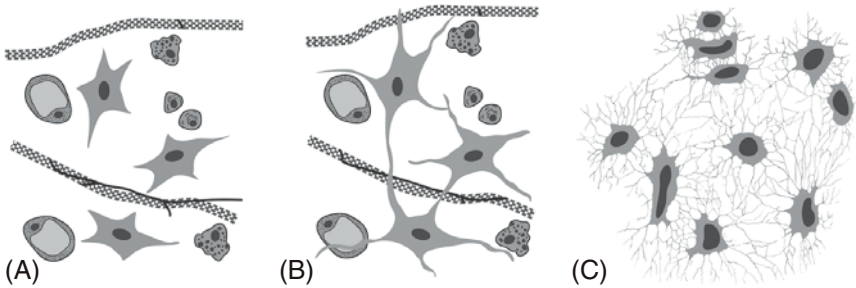

Figure 14.6 (A) Conventional view of the distribution of fibroblasts scattered through loose connective tissue. (B) Revised view with fibroblasts forming a reticular web, possibly extending throughout the tissue. (C) Comparable arrangement of osteoblasts in bone. This is called a syncytium.

Medical Imaging Approaches of Joie P. Jones and Colleagues

Joie P. Jones and his colleagues (Cho et al., 1998) used medical imaging techniques such as functional magnetic resonance imaging (fMRI) and quantitative ultrasonic microscopy to study signal transmission through the meridians and to determine the microscopic structure of the points. Their early work demonstrated that needling specific acupoints on the foot along the Urinary Bladder meridian increases blood flow in certain parts of the visual cortex. These are the same areas that are activated by flashes of light into the eyes. When nearby non-acupuncture points were needled, no such effects were obtained. The fact that these responses were obtained at specific acupoints along a specific meridian, and not nearby, gave support to the meridian concept. Moreover, the points stimulated along the Urinary Bladder meridian were those described in ancient acupuncture texts for treatment of eye disorders. A similar relationship was confirmed between auditory-related acupoints and the auditory cortex (Cho et al., 2000).

Next, Jones (1999) stimulated the same vision-related acupoint (Bladder 67, located on the lateral side of the small toe about 3 mm proximal to the corner of the nail; Figure 14.7) with

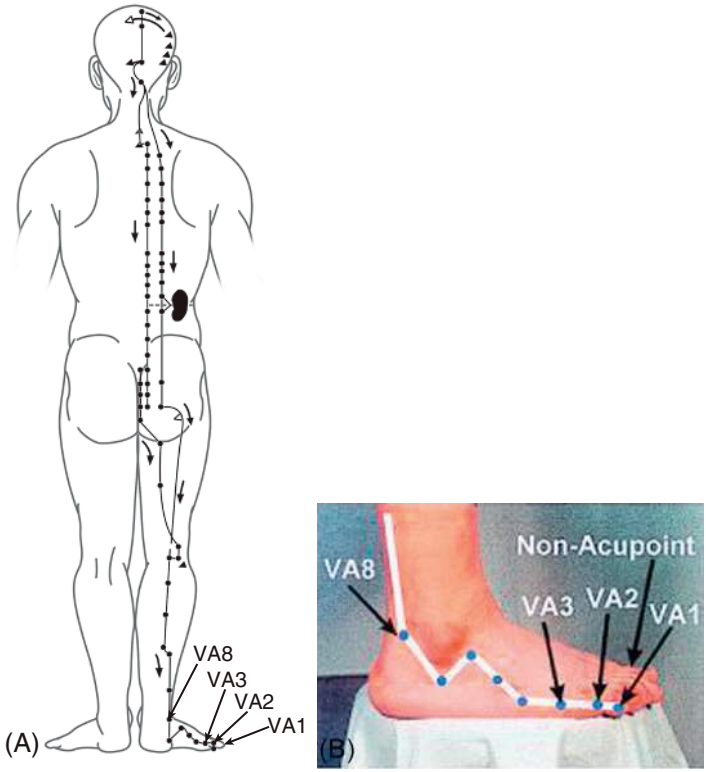

Figure 14.7 (A) The Bladder meridian showing the vision-related acupoints VA1, VA2, VA3, and VA8. These points are known in the oriental acupuncture literature as BL-67 (VA1), BL-66 (VA2, BL-65 (VA3), and BL-60 (VA8), respectively. (B) Location of the vision-related points on the foot.

pulses of ultrasound and monitored the brain activity with fMRI. For a wide range of ultrasound parameters, the fMRI effects on the occipital lobes were indistinguishable from those produced by conventional acupuncture needles. Ultrasonic stimulation of an acupoint required higher energy levels than those used for conventional ultrasonic imaging. Again, there was a close correlation between direct stimulation of the eye using light and stimulation of the vision-related acupoint using either a needle or pulses of ultrasonic energy (Figure 14.8).

The use of fMRI for characterizing brain responses to acupuncture has become widespread, to the point that a literature review has been performed on 779 papers, from the earliest until September 2009. This was literature in English, Chinese, Korean, and Japanese databases. Thirty-four of these papers were eligible for meta-analysis, which showed that acupuncture can modulate the activity within specific brain areas, including somatosensory cortices, the limbic system, basal ganglia, the brain stem, and the cerebellum (Huang et al., 2012).

The next step was to obtain actual images of the acupoints. Conventional ultrasonic imaging used to determine the best placement of the acupuncture needle did not reveal any details of point structure. However, after some experimentation, a method was developed that produced a detailed image. Technical aspects are introduced in the box. A further detailed presentation of the technical aspects was published by Jones et al. (2012). Acupoints correspond to regions of enhanced elasticity (increased ultrasonic attenuation). A challenge was overcoming perhaps the most well-known issue in acoustics: reflection of a plane acoustical wave from a planar boundary. Earlier work had concluded that reflection from a discontinuity in absorption could not occur

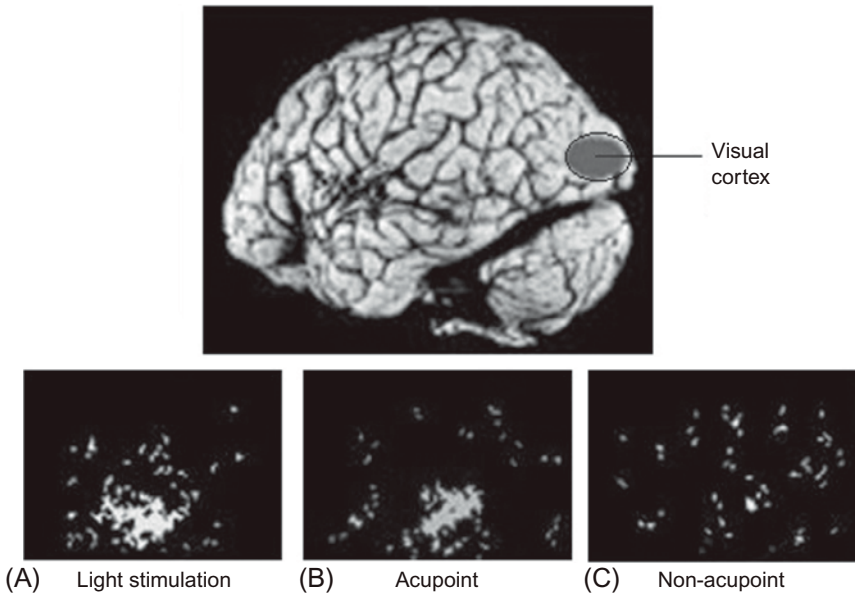

Figure 14.8 Non-acupoint stimulation (control) in comparison with visual and acupoint stimulation. The activation maps of the visual cortex (the shaded area in upper figure) resulting from visual stimulation of the eye (A), acupuncture stimulation at VA1 (B), and non-acupoint stimulation (C), respectively (volunteer 1).

(Linsay, 1960). However, Jones and his colleagues determined that there was an error in Linsay's calculations, and Nolan (1988) reported the analysis in a thesis.

A more detailed or higher resolution ultrasound image requires a higher frequency scanner. Since these were not available, Jones and colleagues switched to a simple pulse-echo data acquisition system using a 50 MHz hand-held transducer. Holding the small (1 mm diameter) transducer on the surface of the skin, a short (30 ns) ultrasound pulse was transmitted into the tissue. The reflected signal, known as an A-mode trace, was recorded and stored in a standard PC. Power levels were well below those required to stimulate the point. The transducer could be moved step by step along a rectangular grid, leading to a series of A-lines. The points proved to be local regions of enhanced attenuation and elasticity. Further technical details are available from Jones and Bae (2004) and Jones et al. (2011).

The technical achievement of imaging the acupoints with ultrasound led to the following discoveries:

- Even in the same person, a given acupoint changed in size, shape, and location over time (Figure 14.9). This led to the realization that acupuncturists who follow the textbook formulas for locating points may mislocate the points about 50% of the time. Ultrasonic localization of acupoints could be used to ensure that the stimulation was applied at the correct location, with the correct amplitude, for the desired effect, all of which would be unknown to the patient. These discoveries reinforce the suggestion of Finando and Finando that acupuncture training include the traditional palpation techniques that were eliminated from the teachings to standardize and streamline acupuncture education.
- Standard acupuncture texts (e.g., Ellis et al., 1991) suggest that an acupoint should be located precisely in relation to anatomical landmarks. However, in the real world, the discerning practitioner typically searches for the acupoint around the standard location, assuming that

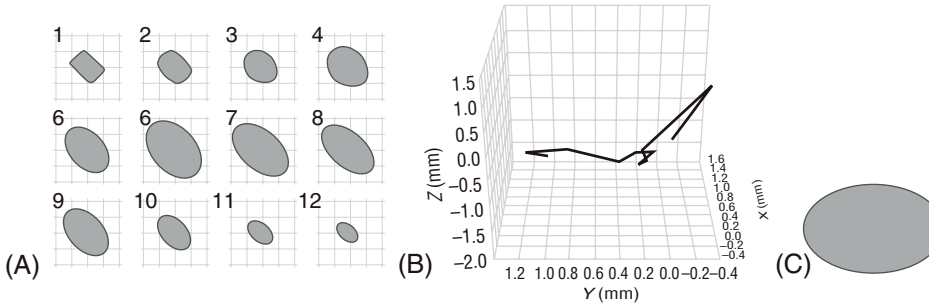

Figure 14.9 (A) Changes in size and shape of acupoint BL-67 over a 12-day period. (B) Changes in relative locations of the center of acupoint BL-67 over a 12-day period. (C) Size of acupoint followed in (B).

the location may be different in each person and may change in time (Miyawaki, 1994). The studies of Jones and colleagues support this approach, as advocated by Finando and Finando.

- Comparing the point location data with textbook anatomical cross-sections shows that all of the points imaged in the Jones et al. (2004) study were located within the connective tissue. This finding agrees with the observations of Langevin and Yandow described above, and with the proposal of the Finandos that the meridians are in the fascia.
- Advances in ultrasonic microscopy by Jones and colleagues enabled more detailed images of the acupoints (Figure 14.10). The point appears to have a polyhedral shape.
- In an ingenious experiment, Jones was able to observe the acupoint while needling it. Remarkably, the points rotate when they are needled. And the top half rotates in the opposite direction compared to the lower half. An interpretation is that the two halves pull on different fascial planes (Figure 14.11).
- In another ingenious experiment, Jones was able to observe the first five points along the Bladder meridian. The points rotated in sequence, with a few seconds delay between the rotation of each point (Figure 14.12).
- Using an ultrasonic pulse to stimulate the acupoint enabled Jones to make precise measurements of the time between stimulation and nerve firing in the occipital cortex. Three different velocities were observed. One was extremely fast, on the order of 7 μs, making it the fastest biological process ever measured. The time delay was within the limit of resolution of the fMRI technique, meaning that it is impossible to know how fast it was. It could have been speed of light or instantaneous. More research on this fascinating topic is needed (Figure 14.12).

The BHS, Renamed the PVS

Research in Asia has revealed a new and novel circulatory system thought to correspond to the acupuncture meridians. For many years this was known as the BHS, Bonghan corpuscles, or Bonghan ducts, named after the North Korean surgeon, Bong Han Kim, who discovered it (Kim, 1963). In 2010, a group of scholars chose, with good reasons, to give the BHS a new name, the primo vascular system (PVS).

There was great interest in this system for nearly 40 years, but it was impossible to confirm its existence because Bong Han Kim never described his methods. A prominent Soviet cytologist condemned it (without evidence) as a fraud (Alexandrov, 1993). A real breakthrough took place with the discovery of a BHS-specific dye, trypan blue (Lee et al., 2009) (Figure 14.13). With this technique, the BHS in adipose tissue became traceable, and the BHS was discovered on the fascia surrounding tumors.

Modern research on the PVS is being done by about 10 groups in Korea and various others around the world. For example, a collaboration between Korean investigators and Bulgarian

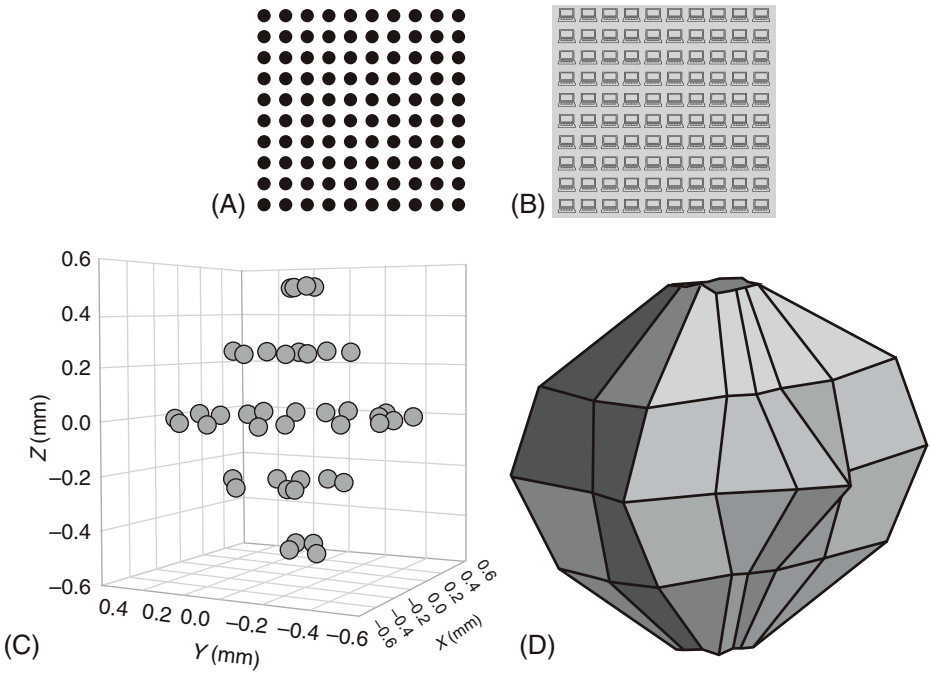

Figure 14.10 (A) Jones and colleagues assembled a 10 × 10 array of transducers, each connected to a 5 GB laptop computer (B). This enabled them to record the three-dimensional shape of BL-67 (C). The transducer operated at 50 MHz. The reflected A-line trace was digitized at 200 Hz. A Two-dimensional grid of A-lines was recorded over the acupoint. Attenuation was calculated along each A-line. (D) Reconstructed attenuation image of an acupoint.

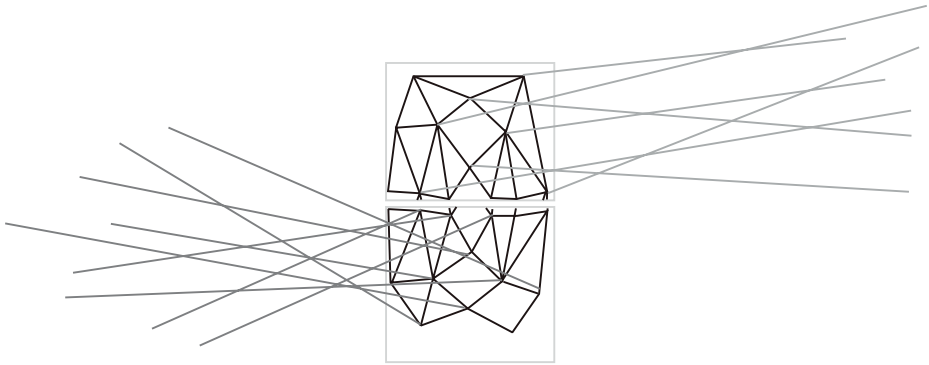

Figure 14.11 Ultrasonic imaging showed that the point (BL-67) rotates during needle insertion. Also, the upper half of the point rotates in the opposite direction to the lower half. One interpretation is that the two halves of the point are connected to different levels or planes in the fascia (see Figure 14.4) and the twisting puts tension on both fascial planes.

scientists resulted in the schemes shown in Figure 14.3 (Stefanov et al., 2013). Many superb illustrations of the system have been published in the *Journal of Acupuncture and Meridian Studies* (JAMS) that was launched in 2008 and published bimonthly since then. There is now little doubt of the existence of this system, and its further study will undoubtedly be very rewarding for every aspect of biomedicine.

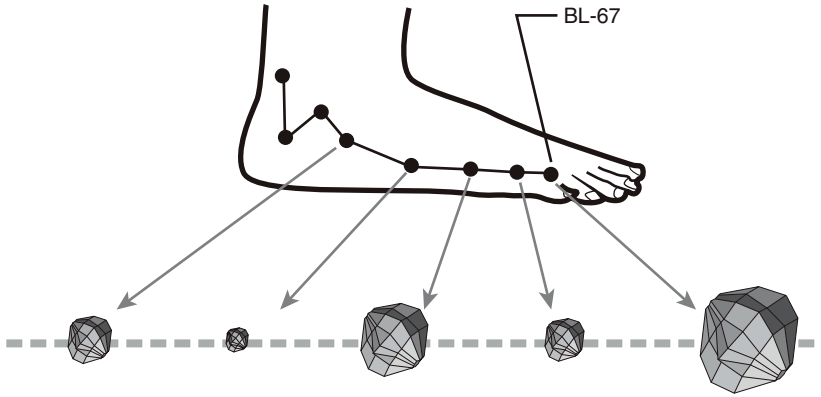

Figure 14.12 Ultrasonic microscopy showed that the points along the Bladder meridian rotated in sequence, with a few seconds delay between each point.

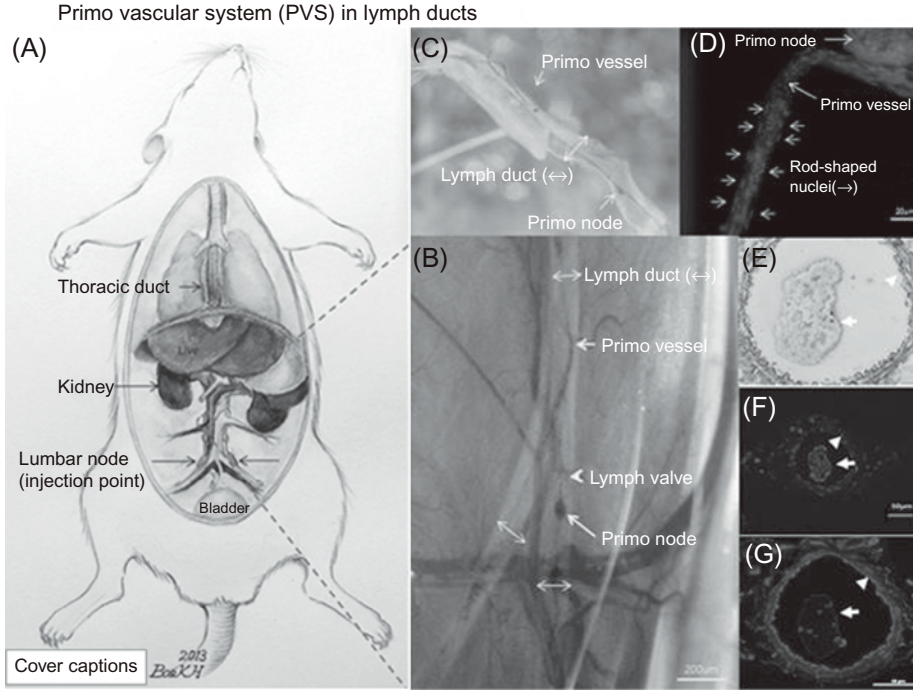

Figure 14.13 (A) The thoracic duct and the lymph ducts (both labelled) around the vena cava in the abdomen of a rat. (B) Stereomicroscopic image of the lymph ducts in the area of (A) indicated by dotted lines. The dark thread-like structures inside the lymph ducts are primo vessels, which become blue by absorbing Alcian blue, which was injected into the lumbar lymph node. Note the branching of the primo vessel at the branching of the lymph duct. The primo node is the corpuscle-like body dangling from the primo vessel. (C) Isolated primo vessel in a lymph duct on a slide. (D) Confocal laser scanning microscope image of DAPI-stained rod shaped nuclei of the endothelial cells in a primo vessel. (DAPI is a fluorescent stain). The nuclei are aligned along the primo vessel's direction. Notice that the primo node is packed with other types of nuclei. (E) Cross-section of a primo node (arrow) in a lymph vessel (arrow head). Gordon and Sweet's silver staining shows the argyrophil fibres in the primo node. (F) EMP-3 immunohistochemical stained image of a cross-section showing the epithelial cells. (G) DiI-stained cross-section. The boundary of the primo node (arrow) shows a positive signal. The primo node is covered with a membrane, which shows that it is not an aggregate of tissue debris or cells. DiI is a lipophilic membrane stain.

Some modern physiologists have put forward a 'neural hypothesis'. They suggest that the clinical influence of acupuncture is transmitted primarily through stimulation of sensory nerves that provide signals to the brain, which processes this information and then causes clinical changes associated with treatment. This is natural, given the tendency of modern biomedicine to attribute just about everything to the nervous system. That the PVS is different from nerves is apparent from the many quality studies done in Korea. Strengthening the foundations of acupuncture meridian theory are specific relationships between acupoints and target organs as demonstrated by the fact that stimulating different acupoints on the body surface can help deal with many different diseases, including visceral issues. Connections between acupoints at the body surface and visceral functions have been elaborated by thousands of years of clinical experience and reinforced recently through extensive research.

Quantum Shiatsu

Patrizia Stefanini is a shiatsu practitioner and quantum physicist. She has looked at her clinical practice through the lens of quantum mechanics, following a direction given to her by her teacher, Pauline Sasaki, who studied closely with Shitzuto Masunaga. Stefanini finds that acupuncture points and meridians, like electrons, are not precisely localized as they are described in texts – they have variable nature and depth. Moreover, their information content is not always related to the present condition of the individual. The movement of meridians agrees with the results of Joie Jones, who found that the location of points changes from day to day (Figure 14.9). Moreover, Stefanini developed an appreciation for the way the wave/particle or energy/matter paradoxes are reflected in her work.

She cites her teachers from the distinguished Istituto Nazionale di Fisica Nucleare (INFN) in Milano (Del Giudice et al., 2009):

> *In living systems, water takes part in the dynamics of life, not only because it accounts for 99% of all the biomolecules but also because it provides energy to living matter. Water has the ability to achieve an extended form of organization and provide an ensemble of different Coherence Domains which are phase locked, thus maximizing their ability to 'look for' energy from the environment. This 'coherence of coherences' of 'biological water' in living systems corresponds to a sort of higher organization. An efficient mechanism of energy transformation from Coherence Domains to biomolecules in living matter guarantees the transfer of biochemical energy necessary for the maintenance of life cycles.*

This quote clarifies the concepts raised in Chapters 10 and 11 of this book. Stefanini also took inspiration from the work of Albert Szent-Györgyi, who wrote in 1957 that the inability of biologists to define animate versus inanimate matter depends on their neglect of the two most important ingredients of living matter: water and electromagnetic fields (and in particular the electromagnetic properties of water). He pointed out that excitation of the electron clouds of the biomolecule and their consequent chemical activation depend on the ordered, quasi-crystalline structure of layers of water, close to the cellular membranes and some hundreds of water molecules thick. The ordered structure of this 'interfacial' water was in turn the consequence of an electromagnetic field that was somehow trapped in the water layers.

We now know from the work of Gerald Pollack (Figure 14.14B) and Mae-Wan Ho that Szent-Györgyi's picture of ordered interfacial water (Figure 14.14A) and fields trapped in the water layers was accurate. Moreover, Pollack demonstrated how fields can accumulate in water layers (Figure 14.14C). These layers adjacent to hydrophilic surfaces form solute 'exclusion zones' as shown in Figure 14.13A.

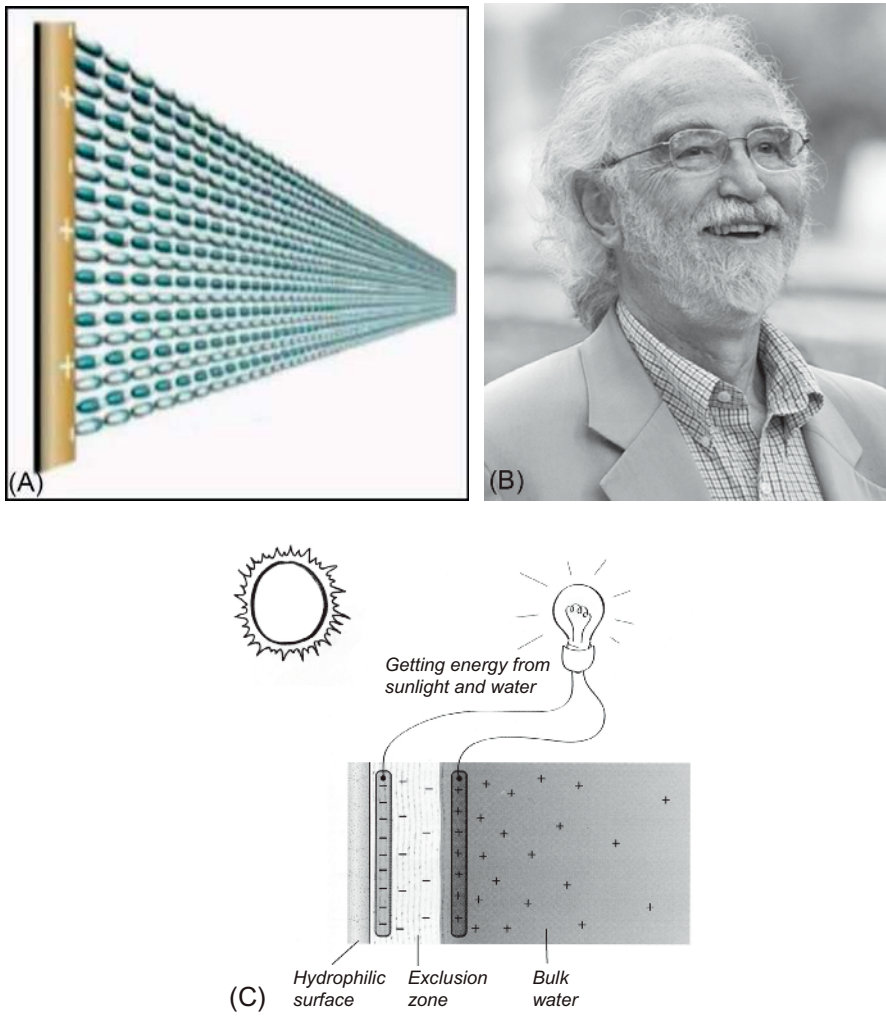

Figure 14.14 (A) The 'exclusion zone' or 'EZ water' at a hydrophilic (water-loving) surface such as a cell membrane or a molecule. (B) Gerald Pollack and his colleagues at the University of Washington in Seattle have made a series of remarkable discoveries about the structure and behaviour of water, described in his book, The Fourth phase of Water (2013) published by Ebner and Sons Publishers, Seattle, WA. One discovery, shown in (C), is that sunlight creates a charge separation between the EZ zone and the bulk phase away from the surface.

The X-Signal System of Manaka

A brilliant overview of biological information theory as it applies to acupuncture has been provided by a leading scientist/acupuncturist, Yoshio Manaka (Manaka et al., 1995). The work has significance for all therapeutic approaches. Manaka began to integrate modern scientific research and classical East Asian or Oriental medical theory with a system he refers to as the X-signal system. As a concept, the X-signal system acknowledges that there are unknown aspects of energy and information flow. (The term 'X' is often used in mathematics and physics to represent an unknown quantity. Solving an equation enables one to determine the actual value of the 'X' or unknown.)

In Manaka's X-signal system there are many unknown communication circuits and informational units. A formal mathematical representation of these unknowns is:

$$X_1, X_2, X_3, X_4, \ldots X_n$$

Manaka conceptualized the X-signal system to represent a 'primitive' regulatory system that is different from the classical nervous and hormonal systems. (See also Chapter 9.)

The X-signal system is primitive in the sense that it arose in evolution long before the nervous system. It is present in single-celled animals, which do not have nerves *per se*, but nonetheless react to external stimuli in order to avoid harm and to attract them to nourishment (Figure 12.5).

Manaka demonstrated that the X-signal system is separate from the nervous system by describing the various treatments used in Oriental medicine that profoundly affect the body without having any effect on the nervous system.

While ancient in terms of evolution, in comparison to the nervous/hormonal systems, the X-signal system is extremely important and potent in the human body because it regulates the communications and cellular migrations involved in defence against disease and wound healing.

In his writings, Manaka presented the X-signal system as a system that is well known from the clinical perspective of Oriental medicine, but that has no scientific basis. However, it is becoming more and more apparent that the energy systems in the living body being documented in this book are all components of Manaka's X-signal system. The energy fields of the body, the perineural system, and the living matrix are some of the substrates through which the X-signal system exerts its effects on cells and tissues. The living matrix, the energy fields, the acupuncture meridians, and the various biocircuits that energy therapists interact with during their therapy sessions are all related and are all components of Manaka's system.

Relation to Acupuncture

How does all of this fit with the theory of acupuncture? We can now show where the individual cell fits into the meridian scheme that is the basis of acupuncture (Figure 14.15). The cytoskeleton – which some biologists are now referring to as the nervous system of the cell – can be fitted into the scheme. The meridian system, which acupuncture theory visualizes as branching into every part of the organism, can be extended into the interiors of every cell in the body and even into the nuclei that contain the genetic material. The meridians are simply the main channels or transmission lines in the continuous molecular fabric of the body.

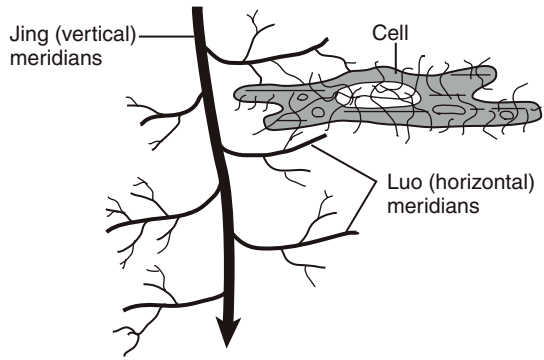

Figure 14.15 A vertical meridian or channel and its horizontal branches, which are envisioned to extend into every part of the body, including the surfaces and interiors of every organ, and even into the individual cells and organelles. *(Meridian drawing taken from Matsumoto and Birch (1988), used by kind permission of S. Birch and Paradigm Publications, Brookline, MA.)*

The molecular web is more than a mechanical anatomical structure. It is a continuous vibratory network. As such, it presents possibilities of profound biological and clinical significance.

A vertical meridian or channel, and its horizontal branches are envisioned to extend into every part of the body, including the surfaces and interiors of every organ, and even into the individual cells and organelles (Figure 14.15).

Hypothesis

Every part of the body, including all of the molecules so thoroughly studied by modern science as well as the acupuncture meridians of traditional East Asian or Oriental medicine, form a continuously interconnected semiconductor electronic network. Each component of the organism, even the smallest part, is immersed in, and generates, a constant stream of vibratory information. This is information about all of the activities taking place everywhere in the body.

Complete health corresponds to total interconnection. Accumulated physical and/or emotional traumas impair the connections (Oschman and Oschman, 1995). When this happens, the body's defence and repair systems become impaired, and disease has a chance to take hold. Acupuncture and other energy therapies restore and balance the vibratory circuitry, with obvious and profound benefits. The body's defence and repair systems are able to repair themselves.

Many individuals, both scientists and therapists, have contributed valuable insights to this emerging picture of how the body functions in health and disease. Phenomena that previously seemed disconnected and unrelated are now complementing one another, giving us a more complete understanding than we could have obtained by any single approach.

References

Alexandrov, V.Y., 1993. The Difficult Years of Soviet Biology: Contemporary Notes. Science, St. Petersburg. Available at: http://vivovoco.rsl.ru/VV/BOOKS/ALEXANDROV/CONTENT.HTM; 1993 (accessed 6.05.13) (in Russian).

Birch, S., Felt, R., 1999. Understanding Acupuncture. Churchill Livingstone, London.

Chen, C.S., Mrksich, M., Huang, S., Whitesides, G.M., Ingber, D.E., 1997. Geometric control of cell life and death. Science 276, 1425–1428.

Chicurel, M.E., Singer, R.H., Meyer, C.J., Ingber, D.E., 1998. Integrin binding and mechanical tension induce movement of mRNA and ribosomes to focal adhesions. Nature 392, 730–733.

Chiquet, M., Renedo, A.S., Huber, F., Fluck, M., 2003. How do fibroblasts translate mechanical signals into changes in extracellular matrix production? Matrix Biol. 22, 73–80.

Cho, Z.H., Chung, S.C., Jones, J.P., Park, J.B., Park, H.J., Lee, H.J., Wong, E.K., Min, B.I., 1998. New findings of the correlation between acupoints and corresponding brain cortices using functional MRI. Proc. Natl. Acad. Sci. U.S.A. 95, 2670–2673.

Cho, Z.H., Na, C.S., Wong, E.K., Lee, S.H., Hong, I.K., 2000. Investigation of acupuncture using brain functional magnetic resonance imaging. In: Lischer, G., Cho, Z.H. (Eds.), Computer Controlled Acupuncture. Pabst Science Publishers, Lengerich, Germany, pp. 45–64.

Cross, J.R., 2008. Acupuncture and the Chakra Energy System: Treating the Cause of Disease. North Atlantic Books, Berkeley, CA, 208 pp.

Del Giudice, E., Puselli, R.M., Tiezzi, E., 2009. Thermodynamics of irreversible processes and quantum field theory: an interplay for the understanding of ecosystem dynamics. Ecol. Model. 220 (16), 1874–1879.

Ellis, A., Wiseman, N., Boss, K., 1991. Fundamentals of Chinese Acupuncture. Paradigm Publications, Brookline, MA.

Finando, S., Finando, D., 2011. Fascia and the mechanism of acupuncture. J. Bodyw. Mov. Ther. 15, 168–176.

Finando, S., Finando, D., 2012. Qi, acupuncture and the fascia: a reconsideration of the fundamental principles of acupuncture. J. Altern. Complement. Med. 18 (9), 880–886.

Henry, R., 2011. Quantum Acupuncture: The Next Level. CreateSpace Independent Publishing Platform, Seattle, WA, 240 pp.

Hong, H. (Ed.), Acupuncture: Theories and Evidence. 2013. World Scientific Publishing Company, Singapore.

Huang, W., Pach, D.D., Napaddow, V., Park, K., et al., 2012. Characterizing acupuncture stimuli using brain imaging with fMRI—a systematic review and meta-analysis of the literature. PLoS One 7 (4), 1–19.
Jones, J.P., 1999. Acupuncture stimulation using ultrasound. In: Proceedings of the International Workshop on New Directions in the Scientific Exploration of Acupuncture. Beckman Center, National Academies of Science and Engineering, Irvine, CA.
Jones, J.P., Leeman, S., Nolan, E., Lee, D., 2011. Reflection and scattering of acoustical waves from a discontinuity in absorption. In: André, M.P., Jones, J.P., Lee, H. (Eds.), Acoustical Imaging, vol. 30, Springer Science, Cham, Switzerland, pp. 279–283.
Jones, J.P., Bae, Y.K., 2004. Ultrasonic visualization and stimulation of classical oriental acupuncture points. Med. Acupunct. 15 (2), 24–26.
Jones, J.P., Bae, Y.K., Wilson, L., So, C.S., Kidney, D.D., 2004. Ultrasonic imaging and characterization of acupuncture points in classical oriental medicine. In: Arnold, W., Hirsekorn, S. (Eds.), Acoustical Imaging. Kluwer Academic Publishers, Dordrecht, the Netherlands, pp. 527–533.
Julias, M., Edgar, L.T., Buettner, H.M., Shreiber, D.I., 2008. An in vitro assay of collagen fiber alignment by acupuncture needle rotation. Biomed. Eng. Online 7, 19.
Kim, B.H., 1963. On the kyungrak system. J. Acad. Med. Sci. 10, 1–41.
Langevin, H.M., Yandow, J.A., 2002. Relationship of acupuncture points and meridians to connective tissue planes. Anat. Rec. 269 (6), 257–265.
Langevin, H.M., Churchill, D.L., Fox, J.R., Badger, G.J., Garra, B.S., Krag, M.H., 2001a. Biomechanical response to acupuncture needling in humans. J. Appl. Physiol. 91 (6), 2471–2478.
Langevin, H.M., Churchill, D.L., Cipolla, M.J., 2001b. Mechanical signaling through connective tissue: a mechanism for the therapeutic effect of acupuncture. FASEB J. 15 (12), 2275–2282.
Langevin, H.M., Cornbrooks, C.J., Taatjes, D.J., 2004. Fibroblasts form a body-wide cellular network. Histochem. Cell Biol. 122 (1), 7–15.
Lee, B.C., Kim, K.W., Soh, K.S., 2009. Visualizing the network of Bonghan ducts in the omentum and peritoneum by using Trypan blue. J. Acupunct. Meridian Stud. 2 (1), 66–70.
Lee, B.C., Soh, K.-S., 2009. A novel model for meridian: Bonghan system combined with fascia (Bonghan-Fascia Model). In Findley, T.W. (Ed.), Proceedings of the Second International Fascia Research Congress, October 27–30. Elsevier, Amsterdam, p. 144.
Linsay, R.B., 1960. Mechanical radiation. McGraw Hill, New York, NY, p. 77.
Longhurst, J.C., 2010. Defining meridians: a modern basis of understanding. J. Acupunct. Meridian Stud. 3(2), 67–74.
MacPherson, H., Hammerschlag, R., Lewith, G., Schnyer, R., 2007. Acupuncture Research: Strategies for Establishing an Evidence Base. Churchill Livingstone, Edinburgh.
Manaka, Y., Itaya, K., Birch, S., 1995. Chasing the Dragon's Tail: The theory and Practice of Acupuncture in the Work of Yoshio Manaka. Paradigm Publications, Brookline, MA.
Matsumoto, K., Birch, S., 1988. Hara Diagnosis: Reflections on the Sea. Paradigm, Brookline, MA, p 142.
Mayor, D., 2006. Electroacupuncture: A Practical Manual and Resource. Churchill Livingstone, Edinburgh.
Mayor, D.F., Micozzi, M.S. (Eds.), 2011. Energy Medicine East and West: A Natural History of Qi. Churchill Livingstone, Edinburgh, 420 pp.
Micozzi, M.S., 2010. Fundamentals of Complementary and Alternative Medicine (Fundamentals of Complementary and Integrative Medicine), fourth ed. Saunders, Philadelphia, PA, 524 pp.
Miyawaki, K., 1994. Comprehensive Extra Meridian Treatment. Ta Ni Ku Chi Pub., Tokyo, Japan.
Myers, T., 2001. Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists. Churchill Livingstone, London.
Nolan, E., 1988. Reflection of acoustic waves from a discontinuity in absorption. MS Thesis, University of California Irvine.
Oschman, J.L., 2007. In: Pishinger, A. (Ed.), The Extracellular Matrix and Ground Regulation. Introduction to the English edition. North Atlantic Books, Berkeley, CA, p. xiii.
Oschman, J.L., Oschman, N.H., 1995. Physiological and emotional effects of acupuncture needle insertion. In: Proceedings of the Second Symposium of the Society for Acupuncture Research. SAR, Boston.
Reichmanis, M., Marino, A.A., Becker, R.O., 1975. Electrical correlates of acupuncture points. IEEE Trans. Biomed. Eng. 22, 533–535.
Stefanini, P., 2011. Ki in Shiatsu. In: Mayor, D.F., Micozzi, M.S. (Eds.), Energy Medicine East and West: A Natural History of Qi. Churchill Livingstone, Edinburgh, pp. 211–222, Chapter 16.

Stefanov, M., Potroz, M., Kim, J., Lim, J., Cha, R., Nam, M.-H., 2013. The primo vascular system as a new anatomical system. J. Acupunct. Meridian Stud. 6 (6), 331–338.
Walthard, K., Tchicaloff, M., 1971. Motor Points. In: Licht, S. (Ed.), Electro-diagnosis and Electromyography. third ed. Waverly Press, Baltimore, MD, pp. 153–170.
Yang, W., 2008. Investigation of the Lower Resistance Meridian III. Acta Sci. Nat. Univ. Pekin. 44 (2), 277–280.