Variability in the Precision of Acupoint Location Methods

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Certificate of authorship/originality

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of Candidate

_____

Mark Aird

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Supporting publications and presentations

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Abstract

The ability to precisely locate appropriate acupoints is, according to both traditional and contemporary theories, essential to deliver acupuncture treatments. More than half of the acupoints defined in acupuncture literature are sufficiently distant to anatomical landmarks, to require the use of specialised techniques in order to locate them. However no research has been conducted to investigate the precision of any manual method (electrical detection is discussed at detail with reference to numerous conflicting research papers).

This thesis details the design, conduct and results of experimentation carried out to measure the precision of four methods (named the directional, proportional, elastic and ruler methods) used to locate acupoints. The methods include two based upon the traditional Chinese anatomical unit of measurement, the *cun*, and two based upon the traditionally reported lengths of areas of the human body. The reasons for selecting these methods, and for excluding others, are explained.

Seventy two subjects were involved in testing the precision of the four methods by applying them when locating a fictitious acupoint. The subjects marked the attempts to locate the fictitious acupoint with invisible ink. The marks were transferred to plastic films and measurements made from reference points.

A significant difference was found between the methods ($F_{3,120} = 11.74$, $p<0.0001$). No significant difference was found between the two traditional methods of point location (directional mean = 11.35, and proportional mean = 11.17) ($p<0.998$), nor between the two variant methods of point location (elastic mean = 7.63, and ruler mean = 6.34) ($p<0.68$). Significant differences were found between the two traditional methods and the two variant methods. The directional method was less precise than both the elastic method ($F_{3,120} = 11.74$, $p<0.007$) and the ruler method ($p<0.00009$).

The proportional method was also less precise than both the elastic method ($F_{3,120} = 11.74$, $p<0.011$) and the ruler method ($p<0.0002$).

Each subject also completed a short questionnaire regarding ease and comfort of use of the four methods. The two more precise methods were generally not well received by subjects in this study. Their two primary concerns were not with precision, but rather of application of the method, and its perceived appearance to patients.

An analysis was also carried out to describe any variation in acupoint location descriptions reported by prominent authors. 151 clinical research papers reporting acupuncture studies were selected according to a number of criteria. The five most frequently prescribed acupoints in these papers comprised the sample used in the examination of seven acupuncture texts. Variability was found between the texts, and is discussed in consideration of the presently poor understanding of the anatomical make-up of an acupoint.

Also examined was the usefulness of measures of sensitivity to palpation used when locating acupoints. No statistically significant difference was found between any of the acupoints tested and the related control points.

The thesis discusses the implications for acupuncture practice, research and education in light of the lack of precision measured, the subjects' preference for the more imprecise methods, the inability to locate or even verify the location of an acupoint using pressure, variability in reported acupoint locations between reference texts, and the related short-comings in published acupuncture research.

Glossary

Term	Definition
acupoint	a discrete area on the body regarded by acupuncturists as physiologically reactive to stimulation
AMED	Allied and complementary Medicine journal database
ANOVA	Analysis of Variance test
CAM	Complementary and/or alternative medicines
CE	Current era
CINAHL	Cumulative Index to Nursing and Allied Health journal database
CONSORT	*Con*solidated *S*tandards of *R*eporting *T*rials. Referred to as the CONSORT Statement
cun	The traditional anatomical inch of TCM
EEG	electroencephalogram
ERP	Event-related potential
fen	One tenth of a *cun*
FP	Fictitious point used as a control point in this thesis
Laser	A modern pain-free practice in which a laser-generated light is focussed onto acupoints in the belief than they are stimulated
MANOVA	Multiple Analysis of Variance test
Moxibustion	A TCM practice, originally practiced independently of needling, involving the burning of a herbal mixture (primarily mugwort) to warm acupoints and other areas of the body
RCT	Randomised controlled trial
STRICTA	*S*tandards for *R*eporting *I*nterventions in *C*ontrolled *T*rials of *A*cupuncture
TCM	Traditional Chinese Medicine
UTS	University of Technology, Sydney

Chapter 1. Introduction

Identification of variability in acupoint location

Texts adhering to Traditional Chinese Medicine (TCM) theory describe acupoint locations in terms of an acupoint's position relative to certain landmarks. Anatomical structures, morphological features, and nearby acupoints make up the landmarks practitioners and researchers use to locate acupoints. TCM acupoint location texts detail the position of 361 acupoints (Rogers and Rogers 1989). About 46% of these acupoints are easily located by reference to immediately adjacent features. Locating the remaining 54% of these acupoints which are distant from any landmarks, requires the use of at least one of several acupoint locating methods (Aird et al 2000).

Traditional methods of acupoint location rely on a unit of measurement known as the *cun*, or Chinese anatomical inch. One *cun* is equal in length to the width of the inter-phalangeal joint of the thumb (Rogers and Rogers 1989). Before the unit is applied on a patient, a practitioner measures the width of the patient's thumb. As the patient's own thumb is used to determine the length of the *cun* unit in each case, the unit is relative to the patient's stature. Location descriptions in TCM texts typically describe acupoints as a number of *cun* from a landmark. This way of locating an acupoint (ie measuring a number of cun from a landmark to the acupoint) is called the directional method of location.

The *cun* is also used in the proportional method of location. In this method, rather than determining the dimension of the *cun* by measuring the width of the first interphalangeal joint of the thumb, areas of the body are described as being a certain number of *cun* long or wide. For example, the length of the forearm between the antebrachial and distal wrist creases is defined as 12 *cun* (Rogers and Rogers 1989). This is illustrated in Figure 1.1.

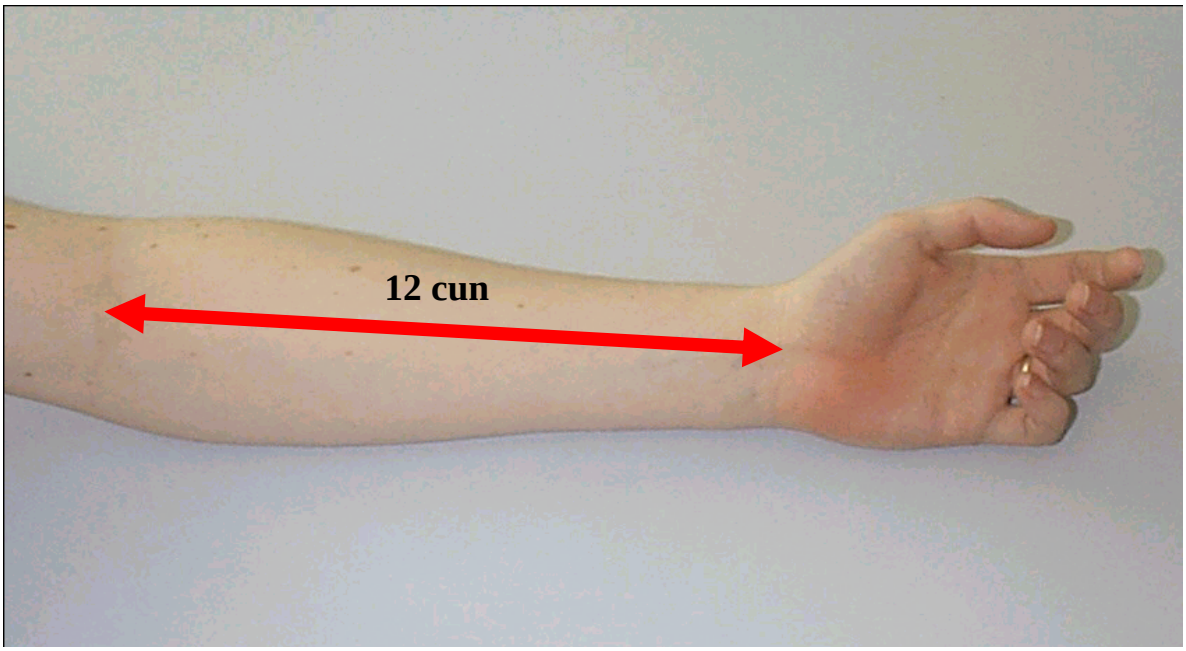

Figure 1.1 The forearm is 12 cun in length

Therefore, when used in this fashion, the length of one *cun* on the forearm is one twelfth the length of the forearm, regardless of the width of the inter-phalangeal joint of the thumb. Although the length of the cun should be the same regardless of the method used, a recent examination of the reliability of the *cun* unit by Coyle et al (2000) demonstrated that in practice the *cun* unit was likely to be unreliable when used to measure a distance from one landmark along a straight line to the acupoint. Rather these authors made a recommendation to use the proportional manner of measurement. The poor reliability of this traditional unit is understandable considering it was developed 14 centuries ago on one specific ethnic population, and is now being applied to very ethnically diverse populations (Eckman 1996).

Research methods in acupuncture research

Contemporary methods of acupoint location may also be affected by reliability issues, however very little research has investigated their reliability despite the variability within and between acupoint location methods creating potentially critical quality concerns. Systematic reviews examining

acupuncture trials almost invariably report that very few acupuncture trials even met the inclusion criteria for the reviews. Many of those that did failed to report the acupoint location methods used.

For example, Claraco, Fargas-Babjak and Hanna (2003) assessed 30 randomised controlled trials (RCTs) of acupuncture for the treatment of headache, migraine, and nausea and/or vomiting. They reported that on average these papers included a little over a third of clinically important information, and only a subset of that information was fully reported. Claraco et al concluded that:

> *...researchers neglected to report adequately on important clinical details, and often did not discuss the reliability, validity, and clinical significance of the outcome measures used in the trials, thus rendering potential readers of the articles unable to critically appraise them from a clinical standpoint.* (p 151)

Steurer-Stey, Russi and Steurer (2002) examined controlled trials and systematic reviews of acupuncture trials for the treatment of asthma. They found that the those papers reporting acupuncture to be effective were themselves poorly designed trials.

Linde, Jonas, Melchart and Willich (2001) examined the methodological quality of research involving various complementary and/or alternative medicines (CAM), including acupuncture. They reported that the published research often had important deficiencies in methodology irrespective of the test modality and methods.

Standards in reporting research

In 1996 the CONSORT statement (*Con*solidated *S*tandards of *R*eporting *T*rials) was published. Its authors discussed fundamental aspects of RCTs which the authors regard as essential to meet a minimum acceptable standard for published RCTs. The CONSORT statement was compiled to assist medical researchers to design and report in a systematic fashion. The desirable outcome is that all relevant and required information is recorded in published research papers. The issues

discussed in the CONSORT statement are fundamental to all randomised clinical trials including acupuncture trials.

Guidelines specific to acupuncture were published after the Foundation for Traditional Chinese Medicine In England recognised that:

> *"Acupuncture treatment and control group interventions in parallel-group randomised trials of acupuncture are not always precisely reported. In an attempt to improve standards, an international group of experienced acupuncturists and researchers devised a set of recommendations, designating them STRICTA: Standards for Reporting Interventions in Controlled Trials of Acupuncture."* MacPherson et al (2002)

The participants involved in development of the recommendations believed that acupuncture research contains peculiarities that could not be appropriately covered by the CONSORT statement. However, while the STRICTA statement specifically targets issues confined to acupuncture research (such as depth of needle insertion, needle dimensions and style of acupuncture), no attention has been given to the possibility of the variability between acupoint locating methods.

Effects of variability in acupoint location

An acupuncture treatment generally comprises four stages:

1. diagnosis of the condition,
2. selection of the prescription,
3. location of the selected acupoints, and
4. delivery of stimulation to the selected acupoints.

Each of these stages requires knowledge of acupuncture. However that knowledge could be derived from traditional Chinese, Japanese, Vietnamese or Korean, or contemporary Western acupuncture theory. More than likely, the knowledge will be a mixture of the former styles, and so each practitioner and researcher will find themselves at some point on the continuum between pure TCM

acupuncture and pure medical acupuncture. The resulting variability in beliefs and practices inevitably will be reflected in both clinical practice and research trials.

Stage three, the location of the selected acupoints, is the stage with which this thesis is concerned. This stage draws upon two areas of knowledge – the location description and the method of finding the location.

A practitioner / researcher must know the locations of the acupoints to be stimulated, or have access to acupoint location descriptions, as well as the ability to understand these descriptions. The selection of source material, or the education received, will also place the practitioner/researcher on the continuum between pure TCM acupuncture and pure medical acupuncture.

Once the location description is known, a method of acupoint location is usually required. It is upon this latter aspect of acupoint location that this thesis is focussed.

Ultimately the style of acupuncture determines what is delivered at each stage and, inturn, the treatment outcome. The results observed in research lead to published advice for practitioners and educators – it is in this way that research typically informs clinical practice. Conversely, the observations made in the clinic lead to word of mouth referrals, the accumulation of which generally result in media reports (such as single case studies) - it is in this way that clinical practice typically justifies research.

Therefore any variability in acupuncture treatment results which occur because of unreliable and/or inaccurate acupoint location methods may eventually be reflected in both clinical practice and research trials. For example, a trial of acupuncture in the treatment of any particular disease may fail to show positive results. While this may be because acupuncture simply is not effective for the

disease, it may also be because the procedures in the trial (for example, the methods of locating the acupoints) were poorly or incorrectly carried out. The result, however, is likely to be the same. New research trials are unlikely to continue to examine the effect of acupuncture on the given disease.

Poor research produces results which can neither be replicated, nor replicate earlier results. Areas of research which fail to show useful and/or consistent (ie reproducible) results are unlikely to receive funding, or participation by industry experts. This ultimately impacts upon clinical practice and education of practitioners and researchers.

Accuracy and precision

An important distinction to make in the analysis of acupoint location methods is between *precision* and *accuracy*. In the context of acupoint location methods, this thesis defines *accuracy* as the proximity between the mean acupoint location found by the practitioner or researcher, and the target location. A high degree of accuracy is shown in figures 1.2 and 1.3, where the scatters are centred on the target coordinate (and therefore the mean location is on the target). Figures 1.4 and 1.5 show low accuracy (ie the mean location found is not centred on the target).

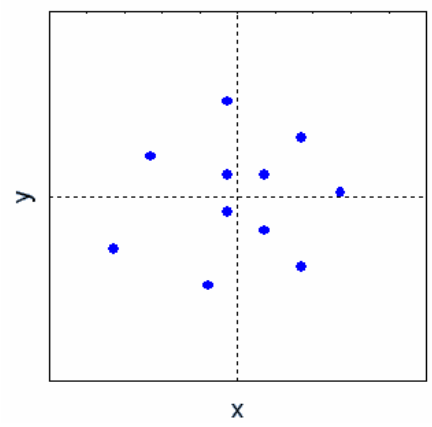

Figure 1.2 High accuracy, low precision

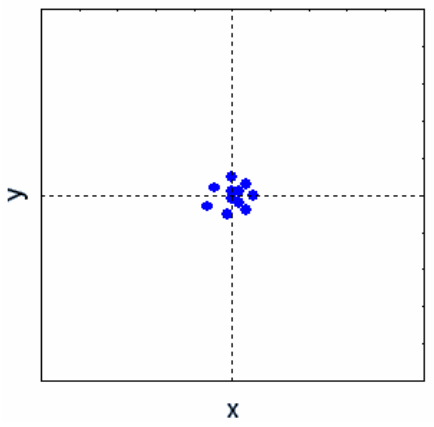

Figure 1.3 High accuracy, high precision

By contrast, the *precision* of a method is related to the size of the scatter resulting from repeated attempts to locate the acupoint. A high degree of precision is shown in both figures 1.3 and 1.5, where the scatters are concentrated into a small area. Figures 1.2 and 1.4 show low precision.

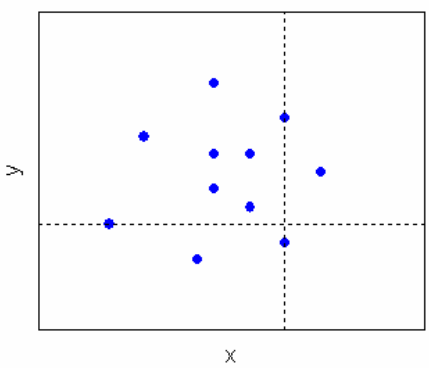

Figure 1.4 Low accuracy, low precision

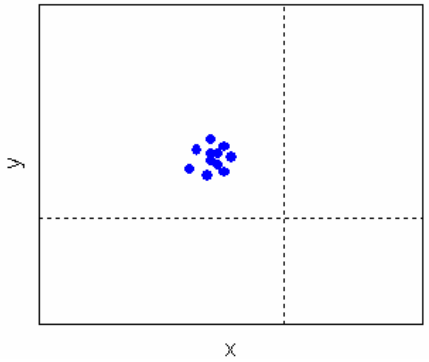

Figure 1.5 Low accuracy, high precision

This thesis focuses on precision of acupoint location methods because there is no known way to verify the 'true' location of an acupoint. Therefore the distance between the 'true' location and an attempted location cannot be measured. Furthermore the required accuracy is unknown, as the surface area of acupoints has not been reliably measured. A search of journal databases revealed extremely little study carried out in this area. The search terms "acupuncture" and "surface area" returned only one published paper from searches of Medline from 1966, CINAHL (Cumulative Index to Nursing and Allied Health) from 1982, Biological Abstracts from 1992, and AMED (Allied and Complementary Medicine) from 1985. This sole report was testing the electrical resistance of small skin points with that of the surrounding skin. The authors (Hyvarinen and Karlsson 1977) described small points (1.5 ± 0.5 mm diameter) as resembling the locations "…of classical acupuncture points." (p 88)

Aird and Cobbin, in a presentation to the Australian Acupuncture and Chinese Medicine Association Symposium in Melbourne, Australia (2001) reported that a detailed survey of published acupuncture research found that while none of the papers specifically defined the surface area of an acupoint, 11% of the papers implied a surface area through the location of 'neutral' control points.

For example, a control point sited 1 cm from an acupoint implies an active surface area for the acupoint of, at most, a 2 cm diameter. The survey found that the implied diameter of an acupoint ranged from 2 mm to 10 cm. No reference was given in any instance to supporting literature for these assumptions.

Aim of this thesis

The variability of results in acupuncture practice and research precludes a definition of 'acupuncture' as a standard practice. Although some efforts have been made to reduce variability in the application of acupuncture (such as STRICTA), no attention has been given to the accuracy of the methods of acupoint location.

The aim of this thesis is to measure the variability of precision within several acupoint location methods, and to compare the precision between the same methods. The outcome will assist future researchers in designing trials to account for what have historically been uncontrolled extraneous variables resulting from acupoint location methods.

Chapter 2. Literature review

Introduction

In the field of acupuncture, little research has been carried out that examines factors such as the reliability or accuracy of methods of locating acupoints. A journal database search was completed to identify relevant research published in Medline, CINAHL (Cumulative Index to Nursing and Allied Health), Biological Abstracts, and AMED (Allied and Complementary Medicine) databases. Results were limited to acupuncture papers that were published in English with abstracts provided, and contained the term "location methods". Only two papers were found: *A study of the comparative accuracy of two methods of locating acupuncture points* by Aird et al (2000), and *The cun measurement system: an investigation into its suitability in current practice* by Coyle et al (2000). Both papers are discussed further below.

Review: A study of the comparative accuracy of two methods of locating acupuncture points

The study's abstract is reproduced below:

> *The ability to locate an acupuncture point accurately is an essential component of both effective treatment and meaningful acupuncture research. This study examined the comparative accuracy of two commonly used mechanical methods of acupuncture point location: directional and proportional. Twenty final-year acupuncture students attempted to locate the points LI.10 (Shousanli) and ST.40 (Fenglong) using each method contralaterally on a volunteer. Both methods are appropriate for use in the locating of these points. Analysis of the results found no significant difference in accuracy between the two methods for either LI.10 (t=1.05, p=0.31) or ST.40 (t=0.59, p=0.57), both methods being found to be similarly inaccurate. The findings of this study demonstrate the serious limitations of both methods for accurate point location.* (p 15)

Three interesting issues were raised in this study. Research published by McKenzie and Taylor (1997) cited earlier results showing more clinical experience could be a causative factor in the deterioration of location skills. It was reasoned that practitioners could(p 239) "…develop

idiosyncrasies in their technique and interpretation of findings, straying from the guidelines employed in training."

While this point was used by Aird to justify the inclusion of students in the research sample, it also underlines the need for greater objectivity in location methods. As acupoint location methods were developed in a less scientific fashion than more contemporary physiotherapy methods, it may be reasonably argued that the acupuncture methods are more vulnerable to "idiosyncrasies" and variances in education and practice. This returns to the earlier point regarding the continuum between pure TCM acupuncture and pure Western acupuncture.

The second point raised by Aird et al in the study was the assumption regarding the surface dimensions of acupoints. Presently no data have been reported which demonstrate how an acupoint can be delineated from surrounding tissue. Therefore any discussion of the required accuracy of acupoint location methods must consider that the larger an acupoint, the smaller the effect of variability in location accuracy, and vice versa. Aird et al made the assumption that an acupoint is indeed a point (ie dimensionless), stating:

> *Although this is in reality highly unlikely, it allows measurements to be made between the correct location of an acupuncture point and the subjects' locations of acupuncture points.* (p 3)

The next issue is how the "correct location of an acupuncture point" can actually be measured in order to make the comparison. The current study therefore examines scatter sizes of repeated location attempts rather than measurements from an arbitrary 'correct' location. This technique allows the measurement of the minimum surface dimensions of an acupoint if 95% of subjects were expected to successfully locate it.

Aird et al (2000) also stated:

> *An assumption made, in order to conduct this study, is that acupuncture points exist. To examine the actual existence or otherwise of acupuncture points, a researcher must first be assured that the correct location of a point can been found to test. Consequently a study such as this must precede any investigation into the objective reality of acupuncture points.* (p 15)

This assumption has been retained in the current work.

The results from the 2000 paper are shown in Figures 2.1-2.4. The white squares are the reference marks used by the researcher to align the recording media. The white circle is the alleged 'correct' location, and the black circles are the subjects' locations. Figures 2.1 and 2.2 show the subjects' attempts to locate the acupoint Large Intestine 10 (LI10) on the left and right arms respectively. Figures 2.3 and 2.4 show the subjects' attempts to locate the acupoint Stomach 40 (ST40) on the left and right arms respectively.

While the researchers did not find any significant relationship between the methods in terms of either overall accuracy or variability along the Y-axis:

> *…a strong relationship was found between the x-axis errors when using the directional method and the x-axis errors using the proportional method for both LI.10 (r=0.55, p=0.01) and ST.40 (r=0.77, p<0.01).* (p 18)

Basically, the further along the X-axis the target point is from the imaginary line between two landmarks, the greater the X-axis error. This is likely due to the action of the tested location methods only operating along the Y-axis. Unfortunately, this means that the Y-axis error is inherent to the methods.

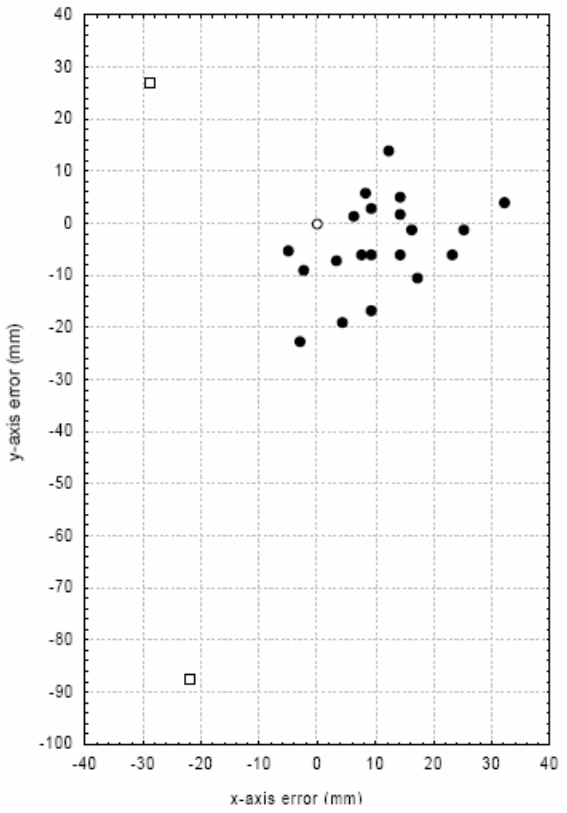

Figure 2.1 Subjects' attempts at LI10 on the left arm

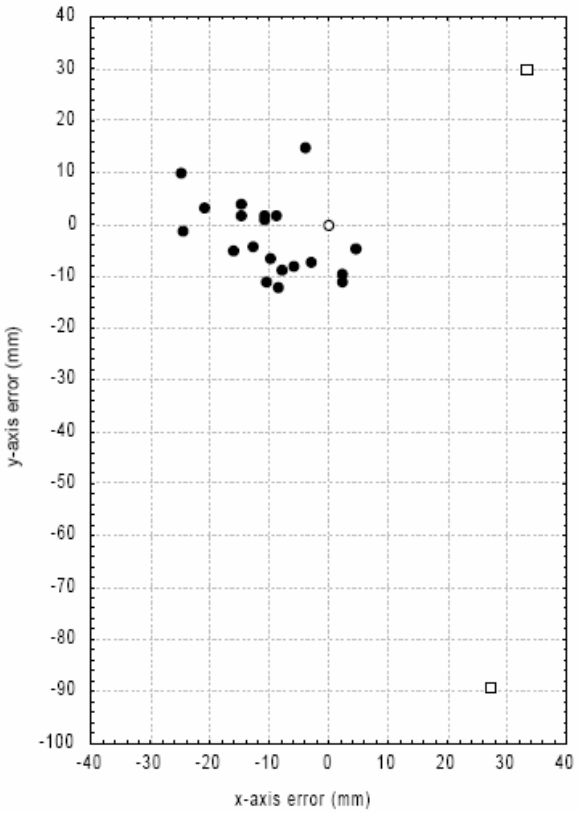

Figure 2.2 Subjects' attempts at LI10 on the right arm

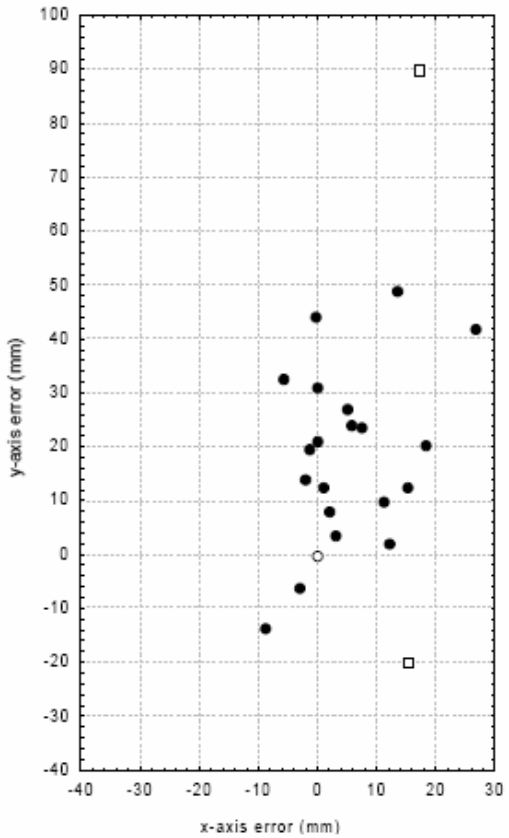

Figure 2.3 Subjects' attempts at ST40 on the left leg

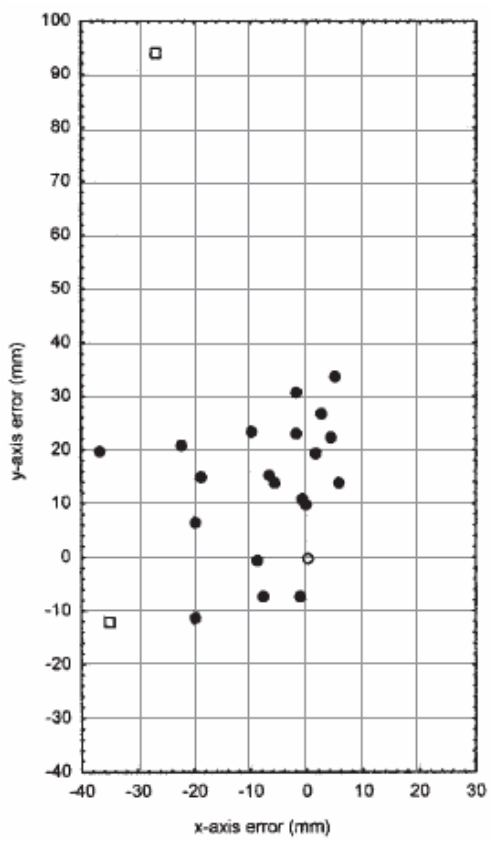

Figure 2.4 Subjects' attempts at ST40 on the right leg

As no difference was found between locating on the left arm/leg from the right arm/leg, Aird et al (2000) combined the above graphs (as shown in Figures 2.5-6 below) and included nearby acupoints to demonstrate a possible effect of poor accuracy.

Figure 2.5 shows the combined results of subjects' attempts to locate LI10 on the left and right arms, and how a nearby acupoint, Large Intestine 9 (LI9), is found within the scattered attempts. Figure 2.6 shows the combined results of subjects' attempts to locate ST40 on the left and right legs, and how nearby acupoints, namely Stomach 37 (ST37), Stomach 39 (ST39), and Gallbladder 37 (GB37), are all found within about 10 mm of the scattered attempts.

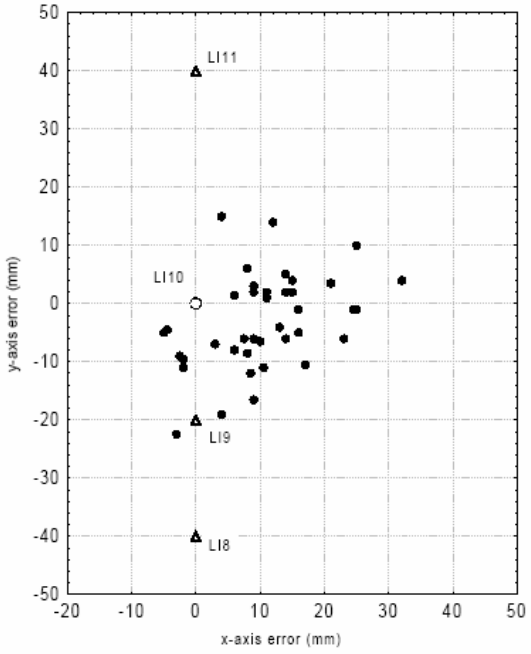

Figure 2.5 Combined attempts on LI10

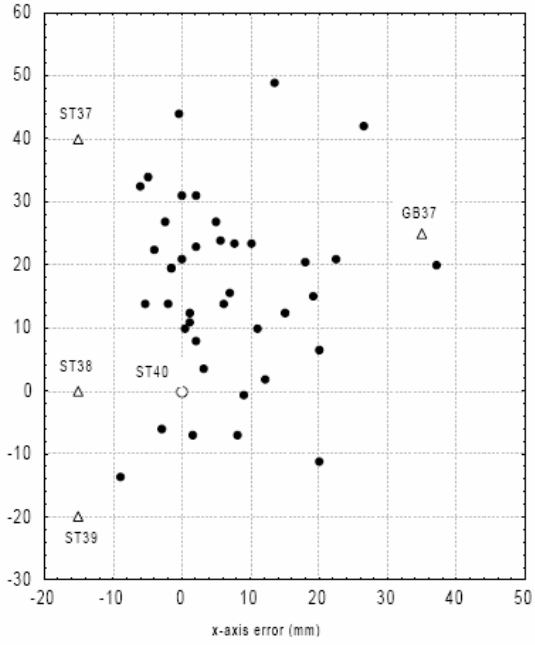

Figure 2.6 Combined attempts on ST40

This trial by Aird et al demonstrated the need for further examination of the methods used to locate acupoints and the repercussions of poor accuracy.

Review: The cun measurement system: an investigation into its suitability in current practice

This paper presented the results by Coyle et al (2000) examining the reliability of the unit of measurement relied upon by the directional method of location. Coyle and colleagues measured the distance between anatomical landmarks used to establish the *cun* size for a patient (shown in Figure 2.7 below), and compared these measurements to the prescribed dimensions of body areas (as discussed earlier in relation to the proportional system of measurement).

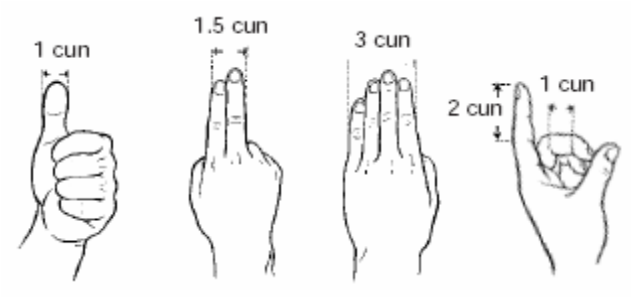

Figure 2.7 Reference landmarks for cun units (Rogers and Rogers 1989)

For example, the forearm is described in TCM texts as being 12 *cun* between the elbow crease and the wrist crease (Rogers and Rogers 1989). Coyle and colleagues then examined whether subjects' forearms were indeed 12 times the width of the inter-phalangeal joint of the thumb.

Coyle and colleagues concluded:

> *…the cun measurement system does not accurately represent contemporary measurements for the hand and leg, and as a consequence will not produce accurate point locations when using the directional method… While the cun measurement system provides reasonably accurate measurements and distances for the arms when using the one cun (thumb) measurement, it is far from accurate for the measurements of the hands and legs. As a consequence, locating acupuncture points using these measurements will be inaccurate.* (Coyle et al 2000 pp 13-4)

This study amplifies the issues raised by Aird et al (2000) regarding use of the directional method. However Aird et al (2000) found the proportional method to be equally inaccurate. This current study was therefore proposed in an attempt to both replicate the earlier results, and to investigate more accurate methods of locating acupoints.

Chapter 3. Examination of four methods of acupoint location

Introduction

In the context of acupuncture, the word ‘point’, although defined literally as a dimensionless entity in English, stems from various Chinese terms that imply an area. Stimulation of acupoints is believed by practitioners to result in physiological effects that typically return body systems to homeostasis. Practitioners rely on different acupoints having different physiological effects; a property which may be referred to as point specificity. Consequently, practitioners must be able to locate an acupoint with sufficient accuracy and precision to avoid stimulating nearby acupoints since they may have effects other than those desired.

The accuracy and precision of point location methods also have important implications for research. Treatment outcomes in clinical trials may be significantly altered if an inaccurate method of point location is applied. For example, if a trial incorporates a placebo treatment group, the use of an imprecise method of point location could lead to accidental stimulation of a nearby acupoint rather than of the intended neutral point. Such errors can give rise to results which may lead to wrongly retaining the null hypothesis and the conclusion that there was no significant treatment effect. Conversely, where an imprecise method is used in a trial, a percentage of needle insertions will have been inserted at a distance from the target acupoint’s centre. If these insertions are beyond the bounds of the acupoint, and the trial reports positive results, the null hypothesis will be rejected despite the effect resulting from penetration of the skin rather than stimulation of the acupoint.

The examined methods

Two methods of acupoint location from which most others are derived are the directional and proportional methods.

1. The directional method

The first method tested, the directional method, measures a number of *cun* from a landmark, along a straight line to an acupoint. Figure 3.1 illustrates this method in the location of Pericardium 6 (PC6) which is located two *cun* proximal to the distal wrist crease, between the *palmaris longus* and *flexor carpi radialis* tendons (Rogers and Rogers 1989). Despite this method's value being compromised due to the poor reliability of the *cun* unit (Coyle et al 2000), and its apparently poor level of accuracy (Aird et al 2000), it is included in this study to replicate the findings reported by Aird.

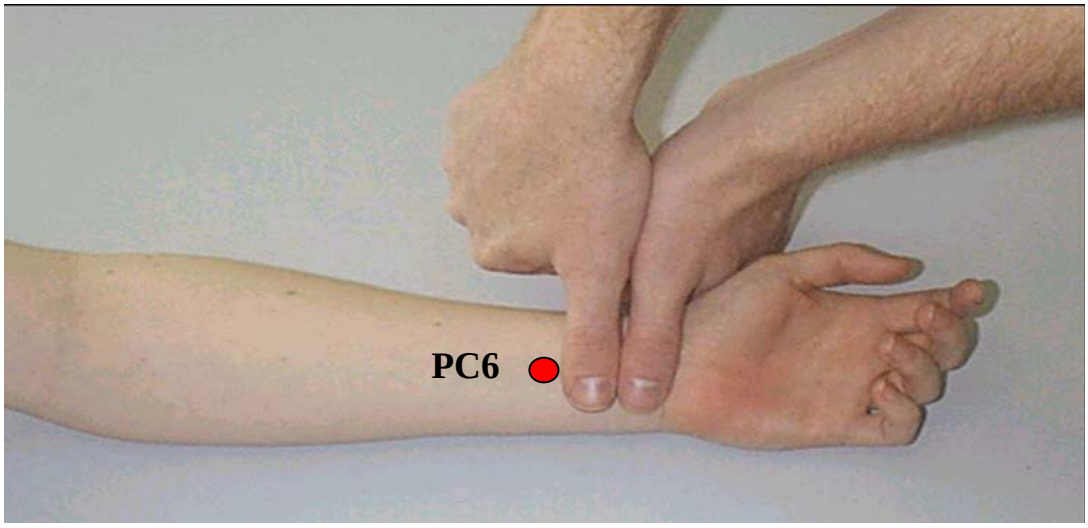

Figure 3.1 Locating PC6 using the directional method.

2. The proportional method

The second method tested, the proportional method, also uses the *cun* unit. However while the directional method defines the length of a *cun* by the width of the interphalangeal joint of the thumb, the proportional method defines the length of a *cun* as relative to the area of the body being measured. The length of the forearm is stated in TCM theory to be 12 *cun* between the antecubital crease and the distal wrist crease (Rogers and Rogers 1989). Therefore the practitioner, in locating PC6 using the proportional method, would divide the forearm (between the antecubital and wrist creases) into two equal segments to first find the six *cun* position (see Figure 3.2). The distal half of

the forearm would then be broken into three equal segments, each two *cun* long. The junction of the first and second most distal segments is the location of PC6 (see Figure 3.3).

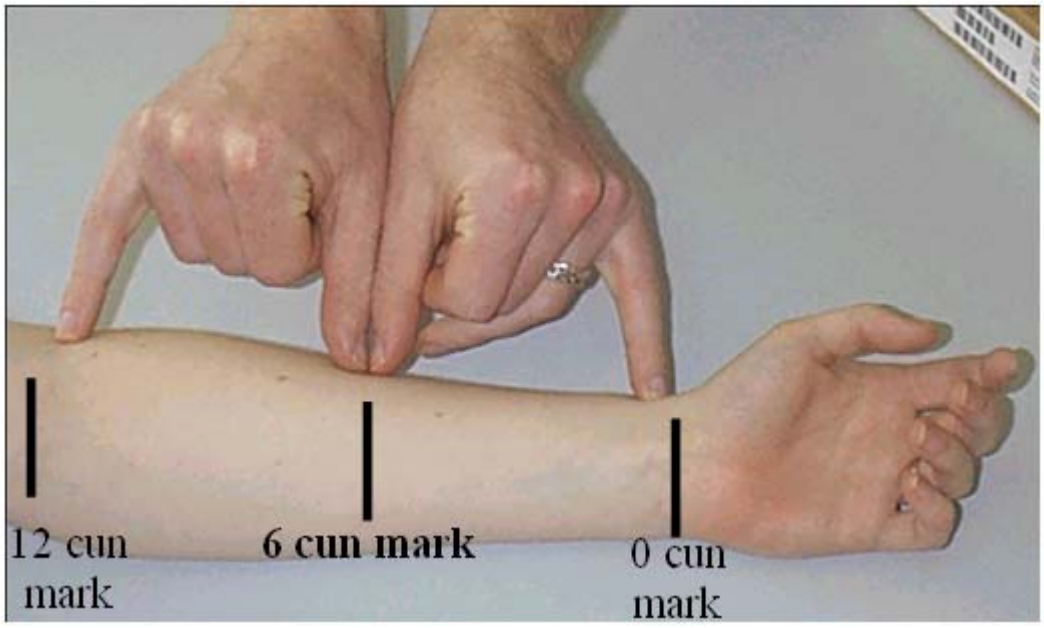

Figure 3.2 Locating PC6 using the proportional method (step #1).

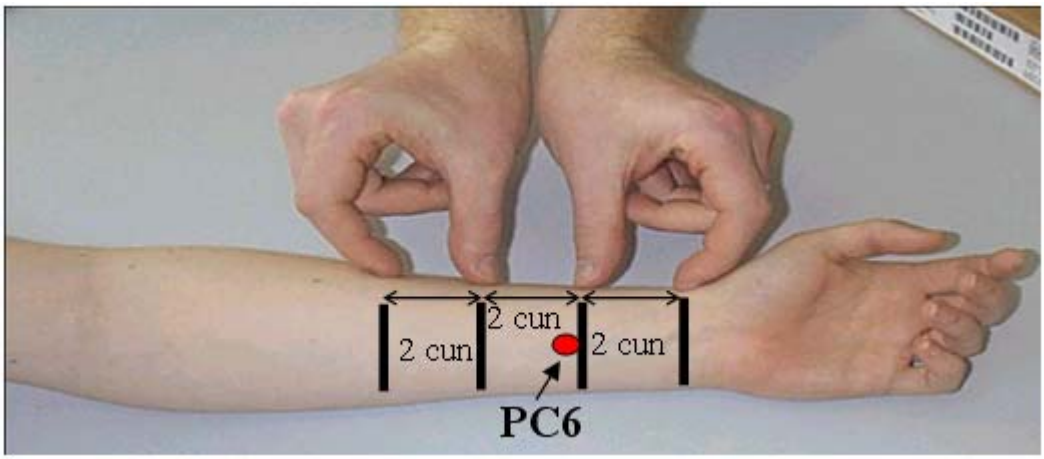

Figure 3.3 Locating PC6 using the proportional method (step #2).

3. The elastic method

The elastic method, a variation of the proportional method, uses a length of elastic with markings at regular intervals. Different lengths of elastic can be used for different parts of the body, with appropriate numbers of intervals marked out. For example, a length of elastic to be used on the forearm would by divided into 12 equal segments (ie 13 markings). The location of the acupoint PC6 would involve stretching the elastic so the first and last marks were held over the wrist and

antecubital creases respectively. The acupoint's location would then be easily found at the third mark (see Figure 3.4).

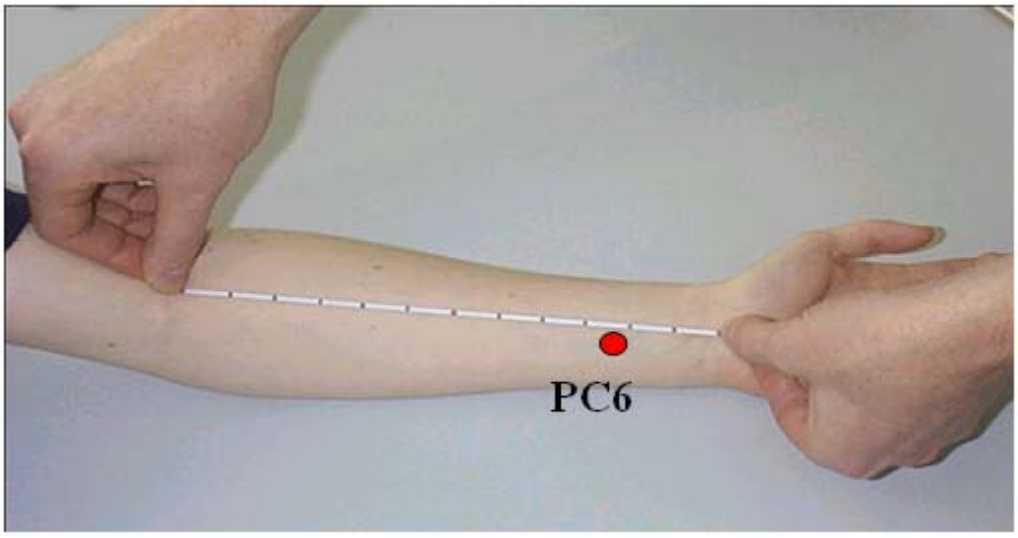

Figure 3.4 Locating PC6 using the elastic method.

4. The ruler method

The ruler method, the fourth method to be tested in this study, is a combination of the proportional and directional methods. It is applied by taking a metric measurement between two landmarks. The measurement is then divided by the relevant number of *cun* units. For example, to find PC6, the length of the forearm would be measured between the wrist and antecubital creases, then that distance divided by 12 to give the length of one *cun* (see Figure 3.5). The length of one *cun* would be multiplied by two and the resulting distance measured from the wrist crease along the forearm to the acupoint (see Figure 3.6).

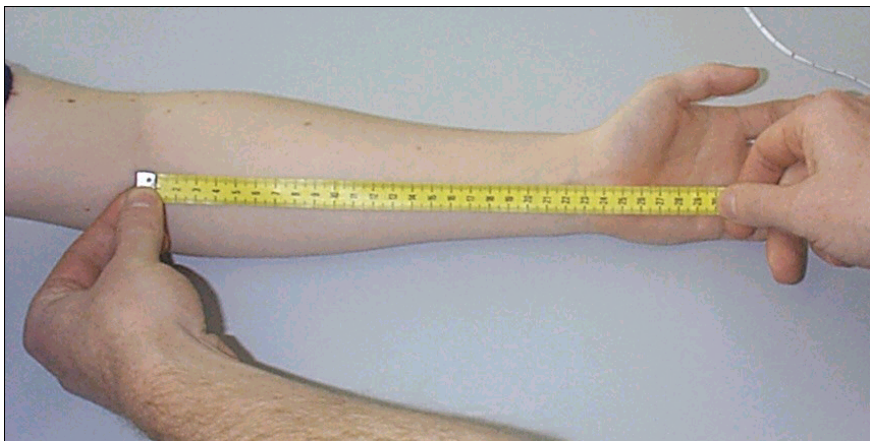

Figure 3.5 Locating PC6 using the ruler method (step #1).

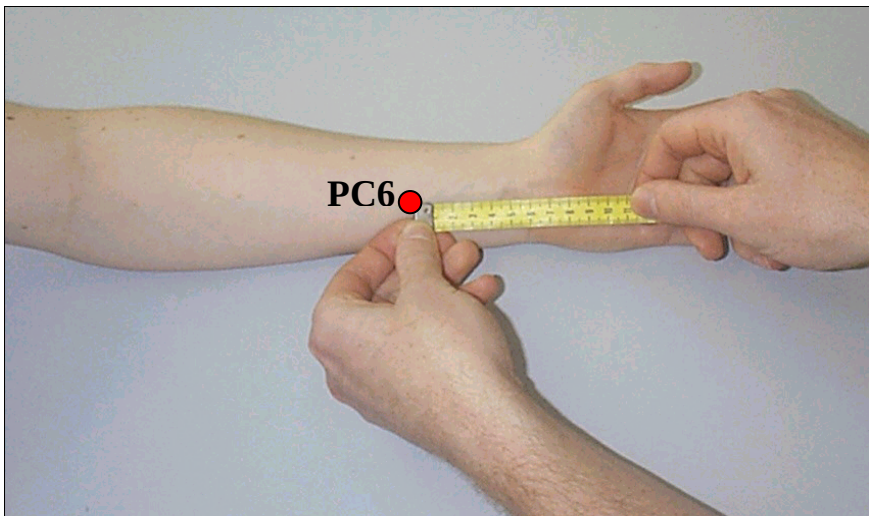

Figure 3.6 PC6 located using the ruler method (step #2)

Locating acupoints by measuring electrical resistance of the skin

Many researchers have attempted to measure and describe the alleged electrical properties of acupoints. These reported properties are however perhaps the most controversial relating to evidence of the existence of acupoints. According to Chen (1996), decreased electrical resistance is believed to be an inherent quality of an acupoint. Electronic devices have been developed in an attempt to locate acupoints via application of a probe to the skin in order to find areas of decreased electrical resistance. However, no consistent findings have been reported to validate this property. On the contrary, many published findings involving these devices have repudiated the existence of such a quality as well as discussing the problems inherent to electronic point detectors. Noordergraaf and Silage (1973):

> *…found that the measured resistance of each point depended on the shape and surface area of the electrode, the force with which the electrode is pressed down, the dryness of the skin, and the inclination of the electrode.* (p 365)

Other artefacts include the pressure applied to measuring probes (Stux and Pomeranz 1995), "…the strength of the measurement current applied, the frequency of the current, whether the current or voltage is constant or varied…and [the probes'] chemical composition" (Birch and Felt 1999 p 170). Research by Pomeranz (Stux and Pomeranz 1995) reported only that acupoints "…do sometimes have lower impedance than surrounding skin" (p 16) but also stated that commercial

acupoint finders which aim to measure skin electrical impedance are "…very unreliable" (p 16). Other factors that were reported to produce inconsistent results included fluctuations due to the time of day, the electrode gel used, the scanning speed of the device, and the temperature and humidity in the room (Yamamoto and Yamamoto 1977, Hot et al 1999, Yamamoto et al 1988, Panescu et al 1993).

Another popular claim is that an acupoint is a voltage source. However Pomeranz claims studies reporting this phenomenon suffer from the same poor methodology as studies of skin impedance readings (Stux and Pomeranz 1995). Pomeranz believes that if acupoints are indeed associated with areas of lowered impedance, then they would consequently be points of current flow between the two poles of the epidermis. Pomeranz reports:

> *Preliminary studies on normal human volunteers in our laboratory indicate that needling the skin produces a decrease in local skin resistance which lasts 1-2 days…a small hole created by an acupuncture needle can create a current of injury (10 mA).*
> (Stux and Pomeranz 1995 p 17)

However this phenomenon is not limited to acupoints and can be replicated at any point on the body.

For the reasons detailed above the location of acupoints by measuring the electrical resistance of the skin was excluded from the experimentation stage of this thesis.

Research method

The sample

The sample comprised students of the Bachelor of Health Science in Acupuncture at UTS. Equal numbers were randomly selected from each of the first, second, and third years of the course, enrolling a total of 72 subjects. Students from the three years were involved to allow analysis of the effect of experience and classroom instruction. Subjects were randomly allocated to eight

independent groups, with equal numbers from each of the three course years in each group. Each group was instructed to apply two of the four methods of acupoint location as shown in Table 3.1.

Group	Right arm	Left arm
A	Directional	Proportional
B	Proportional	Elastic
C	Elastic	Ruler
D	Ruler	Directional
E	Proportional	Directional
F	Elastic	Proportional
G	Ruler	Elastic
H	Directional	Ruler

Table 3.1 Allocation of location methods to groups.

The target acupoint

A fictitious point (FP) on the forearm was defined by the researcher to prevent any practice effect on the results. The location of FP was defined as expressed below and as shown in Figure 3.7:

> *on a straight line between the acupoints Pericardium 7 (PC7) (located between the palmer longus and flexor carpi radialis tendons at the distal transverse wrist crease) and Lung 5 (LU5) (located in the depression lateral to the biceps brachii tendon at the antecubital crease), and five cun proximal to the distal transverse wrist crease. The distance between the two landmarks was defined as 12 cun.*

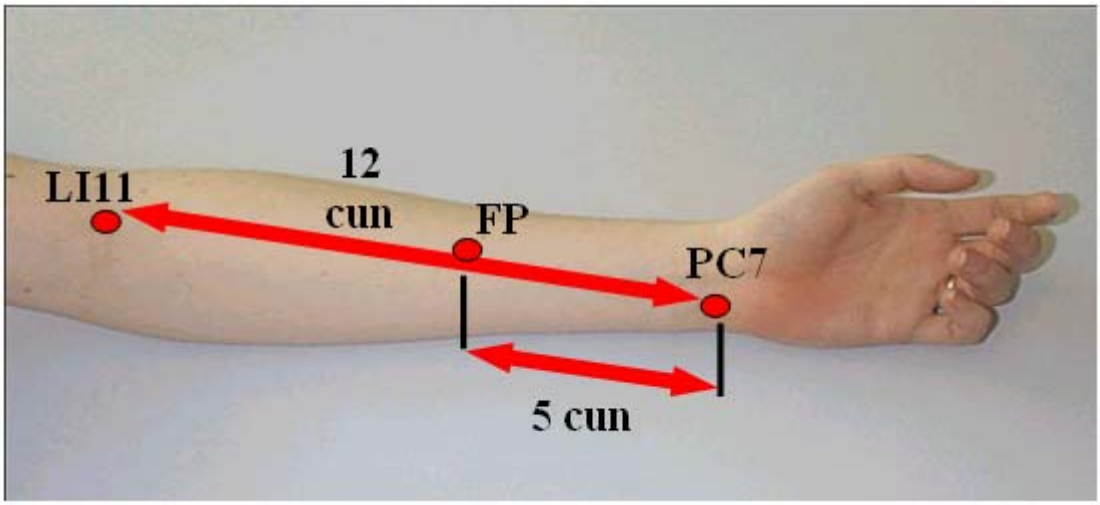

Figure 3.7 The location of the fictitious point (FP).

The patient

One volunteer was enrolled to act as a patient for the study. The same volunteer was used with every subject, and was instructed not to interact with the subjects in any way. Each subject located the FP on both of the volunteer's forearms, using one method on the left arm and a different method on the right arm in accordance with the methods assigned to the subject's group.

Invisible marker ink

Subjects were given a Sanford® Security Marker (No. 12100) with which to mark the location of the FP. The tip of the marker's nib was approximately one mm in diameter, and the ink was water-soluble and easily washed off with soap and water without causing any irritation to the volunteer's skin. The marker's ink was not visible under normal fluorescent lighting, but was clearly visible when illuminated by ultraviolet light. A Vilber Lourmat SVL lamp with two 6 W tubes (365 nm and 254 nm) was used to examine to markings made by each subject.

Recording media

A thin, flexible and transparent plastic film, similar to those used for overhead projection slides, was used to record attempts at location made by each subject on both of the volunteer's arms. Two films were used for each subject; one for the attempts on the volunteer's left arm, and one for attempts on the volunteer's right arm.

Elastic tool

The strip of elastic used for the application of the elastic method was three mm wide, one mm thick, and 220 mm long. A 20 mm space was left at each end of the elastic-ruler. The remaining 180 mm section was divided into 12 equal sections of 15 mm each. Markings were made on the elastic with a permanent black ink marker. A permanent red ink marker was used at the first, last, and centre markings to enhance readability (the five *cun* measurement was therefore one marking short of the

centre red marking). The measurements on the elastic were made using a metal ruler, with the elastic in its natural relaxed state.

Tape ruler tool

A flexible (pliable but non-stretching) tape ruler was used for the application of the ruler method. The tape ruler was 1520 mm long and marked in millimetres and centimetres and the ends were hemmed with metal to protect it from damage and wear.

Reference points

Knowledge of the locations of the reference points, PC7 and LU5 (as described by Rogers and Rogers 1989), were confirmed with each subject prior to testing. Subjects were given three attempts with each allocated method on each arm, and all attempts were made in one sitting. Attempts to locate and mark the position of the FP were made on each arm alternately (ie left, right, left etc).

Intervention

Throughout the procedure, the subject was observed by the researcher to ensure that the subject:

- applied the allocated method,
- applied the method according to the instructions given,
- recalled the description of the target and reference points,
- referred to the volunteer's digits to establish the size of the *cun* unit (for relevant methods), and
- marked the location of the FP as instructed.

The three locations marked on each arm by a subject were plotted onto a plastic film, and the scatter size determined and recorded. The scatter size was determined by summing the distances each subject's locations were from each subject's mean location. For example, for Subject A who marked, using Method B, three locations at (x_1, y_1), (x_2, y_2) and (x_3, y_3), the mean location was

($x_{(x1+x2+x3)/3}$, $y_{(y1+y2+y3)/3}$). The distances between each marked location and the mean location were then summed to determine the scatter size for Subject A for Method B. Data were entered into Statistica® and analysed using a general linear model and applying ANOVA and MANOVA tests.

Survey

At the completion of the intervention phase of the data collection procedure, each subject completed a short questionnaire regarding ease and comfort of use of the various methods of acupoint location. The subject was asked to indicate how easy each method was to apply, and how comfortable the subject would feel using the method in a clinical situation. Both questions were answered using a four-point scale. Subjects were invited to record any comments regarding the methods they had used in the study (comments were optional).

Experiment results

Difference between arms

Analysis of the results found no interaction between scatter sizes, the arm marked or the year of the course from which the subject was drawn. However, a significant difference was found between methods ($F_{3,120} = 11.74$, $p<0.0001$). No significant difference was found between the two traditional methods of point location (directional mean = 11.35, and proportional mean = 11.17) ($p<0.998$), nor between the two variant methods of point location (elastic mean = 7.63, and ruler mean = 6.34) ($p<0.68$). Significant differences were found between the two traditional methods and the two variant methods. The directional method was less precise than both the elastic method ($F_{3,120} = 11.74$, $p<0.007$) and the ruler method ($p<0.00009$). The proportional method was also less precise than both the elastic method ($F_{3,120} = 11.74$, $p<0.011$) and the ruler method ($p<0.0002$). The standard error and scatter sizes are shown in Figure 3.8.

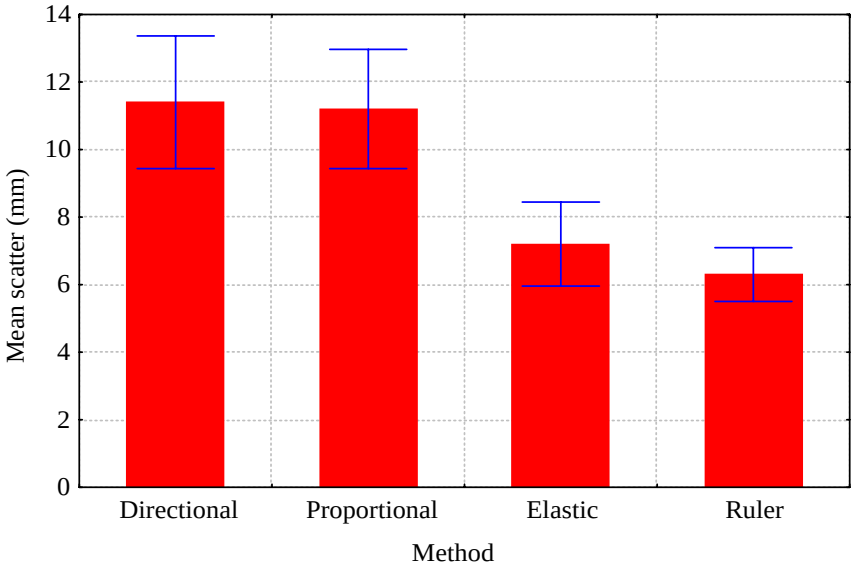

Figure 3.8 Mean scatter and standard error of results for each method ($F_{3,120}$=11.74, p<0.0001).

Scatters for each method

Figures 3.9-12 show the results for the four methods of acupoint location. Since no significant differences were found between mean locations made on right and left arms the results for both arms have been combined in each scatter graph. Each contains an ellipse delimiting the area of 95% confidence. Figure 3.9 shows the results for the directional method of acupoint location. The ellipse measures 36 mm across the minor axis and 45 mm along the major axis and has an area of 12.7 cm^2. Figure 3.10 shows the results for the proportional method of acupoint location. The ellipse measures 27 mm across the minor axis and 37 mm along the major axis and has an area of 7.8 cm^2. Figure 3.11 shows the results for the elastic method of acupoint location. The ellipse measures 15 mm across the minor axis and 28 mm along the major axis and has an area of 3.3 cm^2. Figure 3.12 shows the results for the ruler method of acupoint location. The ellipse measures 12 mm across the minor axis and 31 mm along the major axis and has an area of 2.9 cm^2.

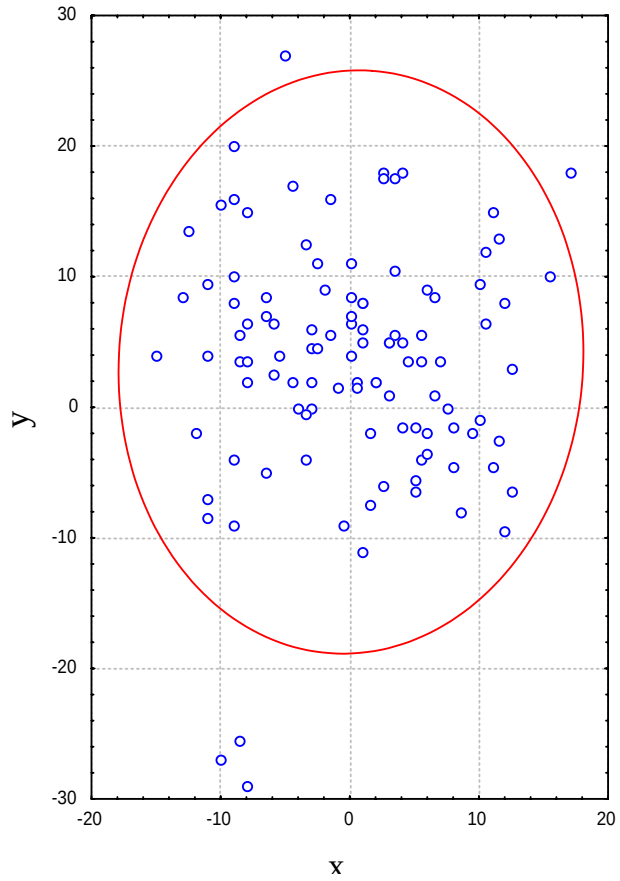

Figure 3.9 Directional method results (area of 12.7 cm^2).

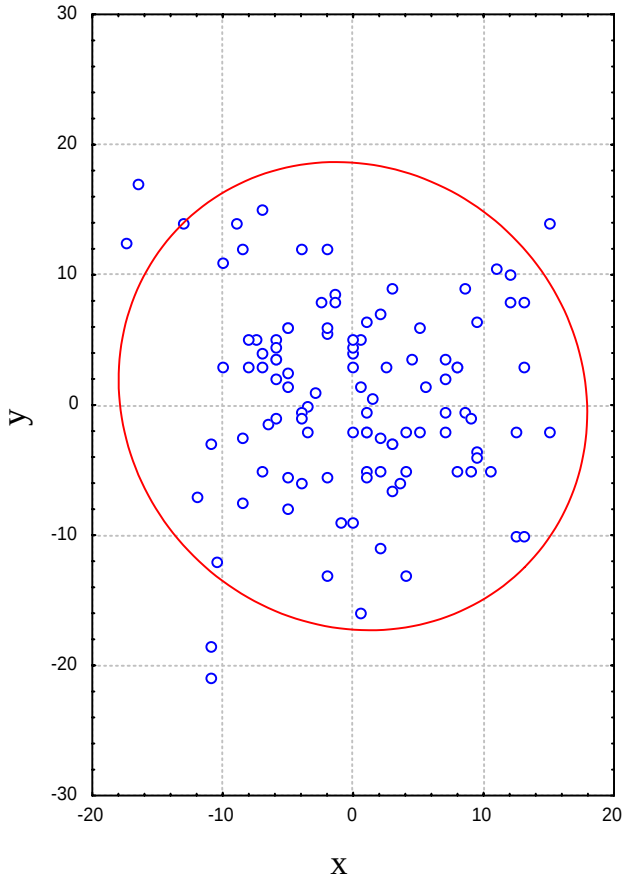

Figure 3.10 Proportional method results (area of 7.8 cm^2).

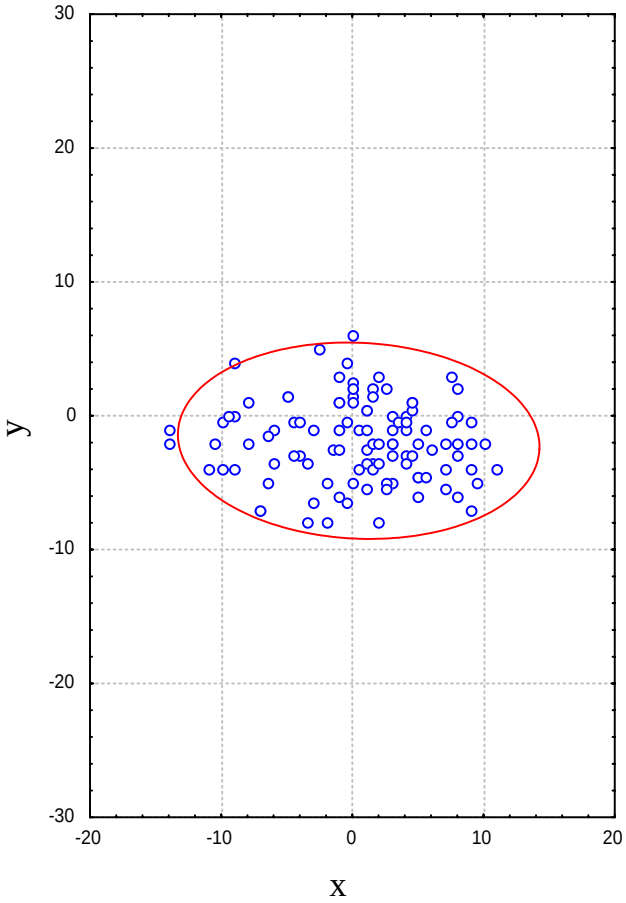

Figure 3.11 Elastic method results (area of 3.3 cm^2).

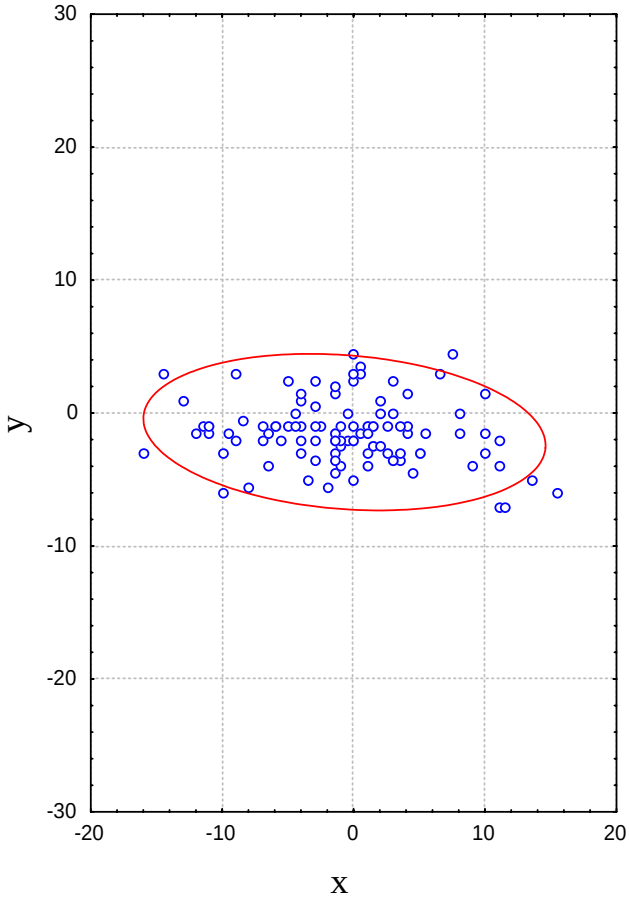

Figure 3.12 Ruler method results (area of 2.9 cm^2).

Nearby acupoints

Figures 3.13-16 show how the use of each method might impact on which acupoint is ultimately stimulated. The acupoints shown in the graphs below are all on the forearm of the volunteer patient (the fictitious point is about a centimetre to the left of PC5 in the middle of each graph). The grid lines form square centimetres. The overlap of points when using the directional and proportional methods is obvious. The same problem is not seen with the elastic and ruler methods.

When a placebo needle is introduced into research, it is often placed only a short distance, sometimes only millimetres, from the treatment point. Figures 3.13-16 shows how easily the placebo needle could be inserted into the target acupoint, or even a nearby acupoint.

Ease of use

Subjects rated the methods they used according to the ease of use during testing, and the degree of comfort using each method in a clinical scenario. A four point scale was provided for both ease of use (very easy, easy, difficult, very difficult) and degree of comfort (very comfortable, comfortable, uncomfortable, very uncomfortable). While most subjects found the directional, proportional and ruler methods were very easy or easy to use, subjects were divided between ‘easy’ and ‘difficult’ for the elastic method. In terms of subjects’ perceived degree of comfort when using the methods in a clinical situation, most rated the directional and proportional methods as either ‘very comfortable’ or ‘comfortable’. Almost half of ratings for the elastic and ruler methods were for ‘uncomfortable’, with the majority of the remaining subjects fairly evenly divided between ‘comfortable’ and ‘very uncomfortable’.

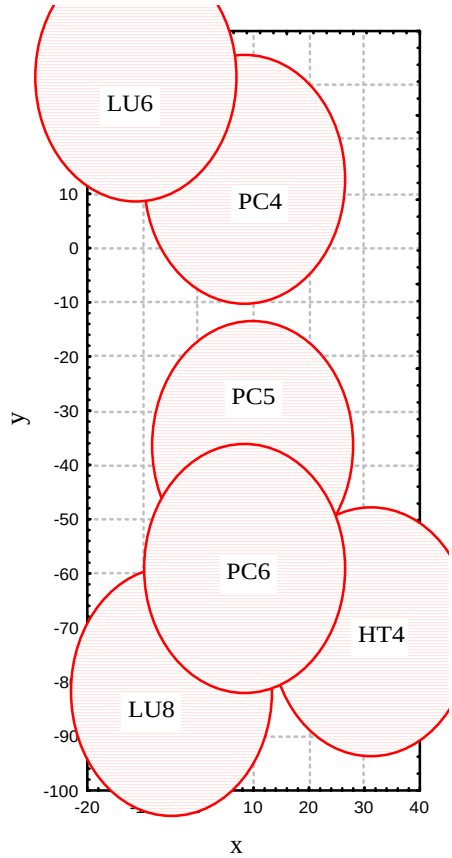

Figure 3.13 Nearby acupoints affected when using the directional method.

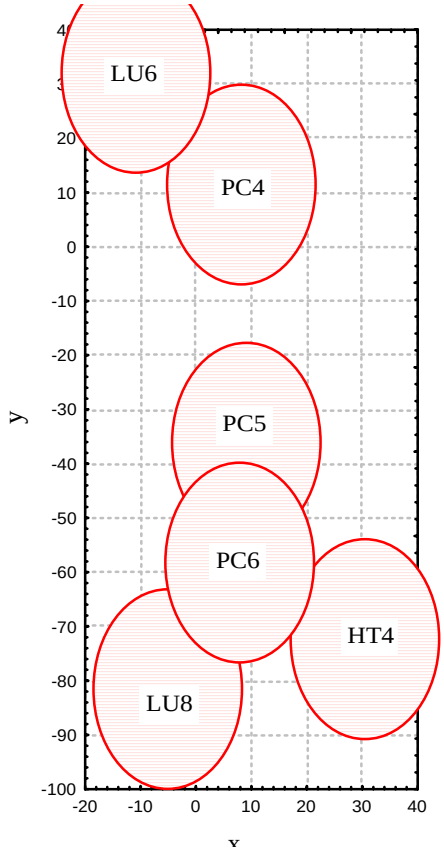

Figure 3.14 Nearby acupoints affected when using the proportional method.

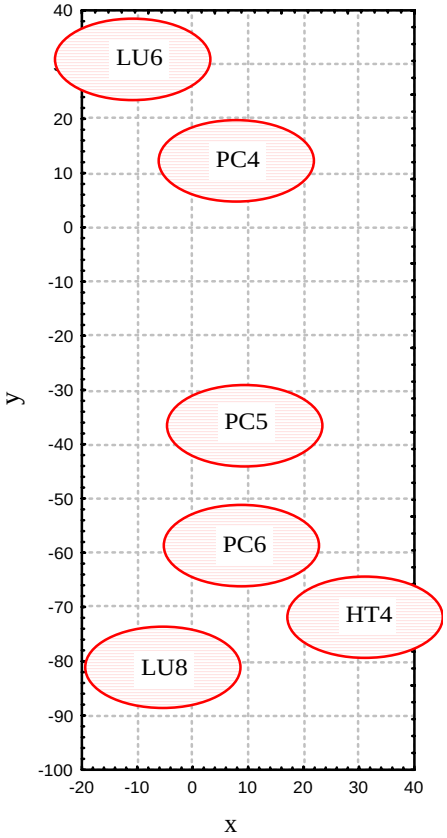

Figure 3.15 Nearby acupoints affected when using the elastic method.

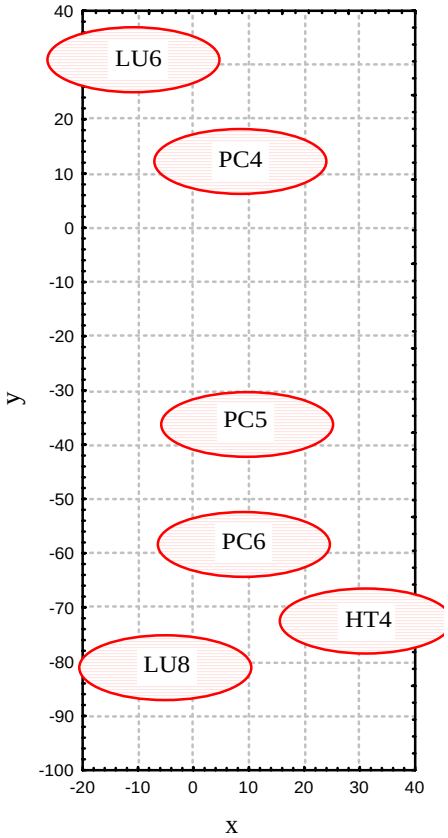

Figure 3.16 Nearby acupoints affected when using the ruler method.

Subjects' comments

The comments collected from the questionnaires were categorised according to cause of concern and the method from which the comment arose. The degree of difficulty of applying a method made up 42.6% of all comments, followed by the perceived professionalism of the method (26.4%), and inaccuracy (23.5%). The elastic and ruler methods were the cause of 100% of concerns about perceived professionalism and 86% of concerns about the degree of comfort in a clinical situation.

Dependence upon accurate and precise locating of acupoints

Patient welfare, clinical efficacy, and valid research results depend upon accurate and precise locating of acupoints. This study has shown that the directional method and the proportional method, the most widely used of the acupoint location methods, are grossly imprecise. The surface area of an acupoint would need to be almost 13 cm^2 for 95% of subjects in this study to locate the acupoint, while the proportional method would require acupoints to be almost 8 cm^2. These areas would rule out any specificity of function for acupoints due to the resulting overlap of points. By contrast, the elastic and the ruler methods were significantly more precise, with the surface areas of about 3 cm^2 for 95% of subjects to locate the point.

Subject acceptance of contemporary methods

Unfortunately, the two more precise methods were generally not well received by subjects in this study. Their two primary concerns were not with precision, but rather of application of the method, and its perceived appearance to patients. There was little difference in this respect between the first, second, and third year students.

The reasons given by subjects for not using the more precise methods in a clinical situation do not, however, impact upon their use in a research setting. Clinical research designed to examine the effectiveness of various acupuncture treatments must use, and report the use of, the most precise

method available. Application of either the traditional directional or proportional methods is likely to introduce uncontrolled extraneous variables, and thereby risks invalidating the results due to type II errors. As such, the results of past research must be viewed in light of the method of acupoint location used in each case. This obviously includes those studies that do not state the method used. In particular, the results of the present study suggest an alternative explanation for the often reported lack of significant difference between active and placebo acupuncture treatment groups, especially in studies where the placebo acupoint is located a very small distance from the acupoint.

Ultimately, the task at hand is to instruct students in the most precise and accurate methods, rather than sacrificing experimental validity and clinical effectiveness for adherence to traditional methods. When conducting research, a suitably educated practitioner of acupuncture should be enlisted to assist in carrying out the procedure, and authors must report the acupoints used, the theoretical locations of these points, and a detailed account of the methods used to find them. However the results of a survey reported by Aird and Cobbin (2001) found that of a random sample of 115 acupuncture studies published between 1995 and 1998 in Western medical science journals, over 64% did not mention how the acupoints were located (shown in Figure 3.17). As different methods of locating acupoints manifest varying degrees of precision, a failure to report which method was used prevents appropriate interpretation of the results. If new researchers tried to replicate such studies, different results are very possible if different methods of locating acupoints are used, or even if similar methods are used but applied differently. Aird and Cobbin also reported that the majority of authors who did report how acupoints were located used the directional method, but half of those authors did not use the relative *cun* unit, but instead measured an equal metric distance from a landmark on all subjects regardless of each individual's physical dimensions. This means variability would have been introduced in the accuracy of acupoint locations due to variability in patient stature.

In Figure 3.17, the method ‘anatomical’ refers to the practice of locating an acupoint by referring to nearby anatomical landmarks. As discussed earlier in this thesis, approximately 46% of the 361 (channel) acupoints are easily located by reference to immediately adjacent features and do not require the use of a location method. The method ‘electric’ in Figure 3.17 refers to the practice of locating acupoints by measuring the electrical resistance of the skin.

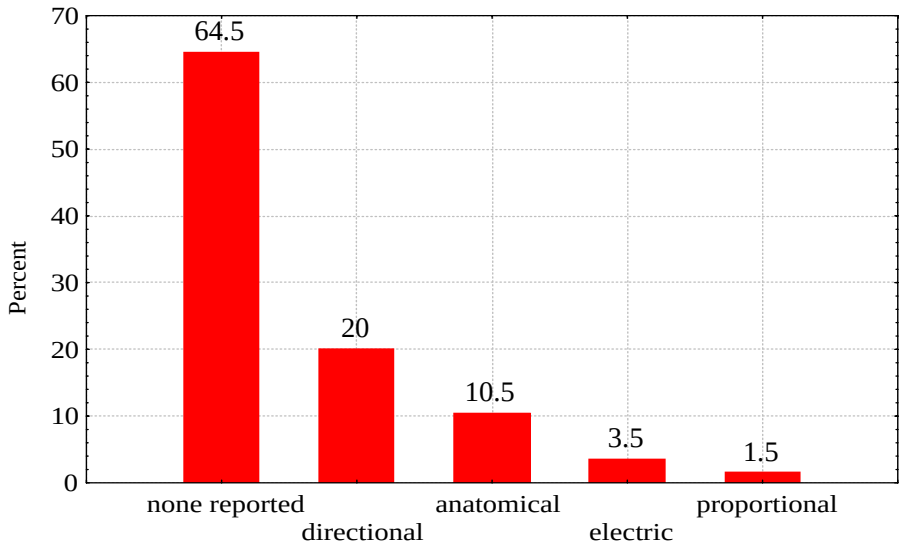

Figure 3.17 Reported use of methods of acupoint location.

Chapter 4. Inter-text comparison of acupoint location descriptions

Introduction

While conducting an analysis of the background literature for this research it became apparent that the acupoint location descriptions described by prominent authors varied. This chapter reports the outcomes of and analysis carried out to describe the variation. The analysis comprised:

1. an pilot study to examine the scope of the variation,
2. a survey of six years of relevant research to establish the most commonly prescribed acupoints, and
3. case studies of the variability in published acupoint location descriptions for the five most prescribed acupoints.

Pilot inter-text comparison

Pilot methodology

For the comparison, two contemporary texts were chosen (*Point Location and Point Dynamic Manual* by Rogers and Rogers 1989, and *A Manual of Acupuncture* by Baker and Deadman 2000), together with a traditional text (*Acupuncture: A Comprehensive Text* translated by O'Connor and Bensky 1981), and a classical text (*The Systematic Classic Of Acupuncture And Moxibustion* compiled by Huang-Fu Mi and translated by Yang and Chace 1994).

Rogers and Rogers (1989) is the prescribed text for the UTS acupuncture course. Most practitioners are familiar with the Baker and Deadman manual as this has become a very popular reference. Similarly, the O'Connor and Bensky translation of the Shanghai College text has been a highly regarded reference for many years. The Systematic Guide is probably rarely used by anyone and was included to look at how acupoint locations were originally described.

The language and terminology used by the texts varied extensively. The two contemporary texts (Rogers and Rogers, and Baker and Deadman) both used accepted medical language, as did the O'Connor and Bensky translation. In general however, Huang-fu Mi's manual did not. It used very vague terms and descriptions, such as describing an acupoint as being under the knee, without any other reference. This text also failed to list several acupoints at all. The O'Connor and Bensky translation also omitted a small number of acupoints. This is not revealed by the comparison. If three texts agreed on a location and the fourth did not list any description, for the purposes of this survey, this was regarded as being a 100% agreement. This was based upon the assumption that if a researcher required a text for location and the text failed to list the acupoint, that researcher would be forced to look elsewhere.

Acupoint nomenclature was different in each text. This did not create a particular problem for the comparison, but where errors were made in a text, and several were found in the translation of the *Systematic Classic of Acupuncture and Moxibustion*, the difference in nomenclature increased the difficulty in overcoming the error. This is a concern for a researcher who does not have an education in acupuncture, as such errors would be more likely to go unnoticed and be acted upon as if correct.

Pilot results

For each channel, Figure 4.1 shows the proportion of acupoint locations which were agreed upon between the texts. For example, the Lung channel, had only two of its 11 acupoints described in a common location in all four texts. Three locations were agreed on by three texts, a further three locations by only two texts, and three acupoints were described as being in different locations in each text. The least agreed upon acupoints belonged to the Triple Heater channel (seven Triple Heater acupoints were described as being in a different location by each of the four texts). The

Governor Vessel was most agreed upon (18 acupoints had two locations described between the texts, and the locations of the remaining 10 acupoints were agreed upon by all four texts).

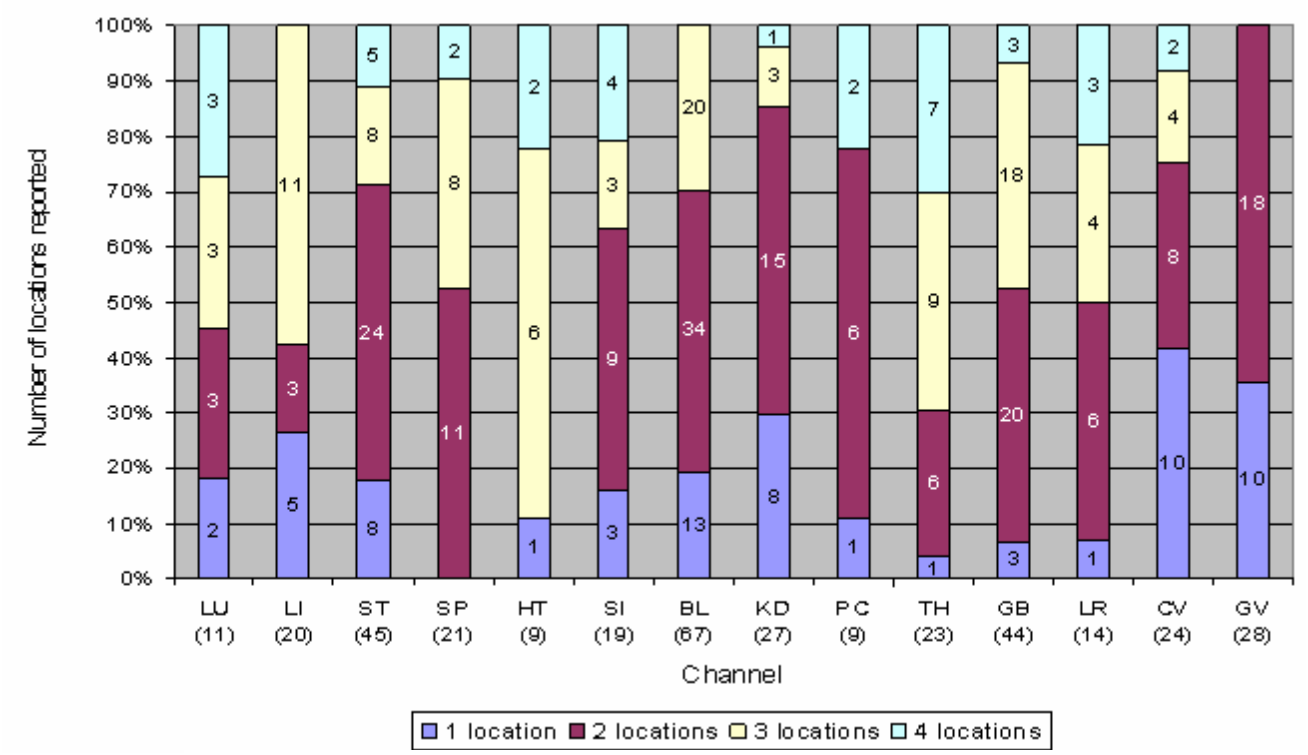

Figure 4.1 Percentage agreement on acupoint location descriptions between texts.

LU *Lung*	*LI* *Large Intestine*	*ST* *Stomach*	*SP* *Spleen*	*HT* *Heart*	*SI* *Small Intestine*	*BL* *Bladder*
KD *Kidney*	*PC* *Pericardium*	*TH* *Triple Heater*	*GB* *Gallbladder*	*LR* *Liver*	*CV* *Conception Vessel*	*GV* *Governor Vessel*

Table 4.1 Key to channels described in Figure 4.1

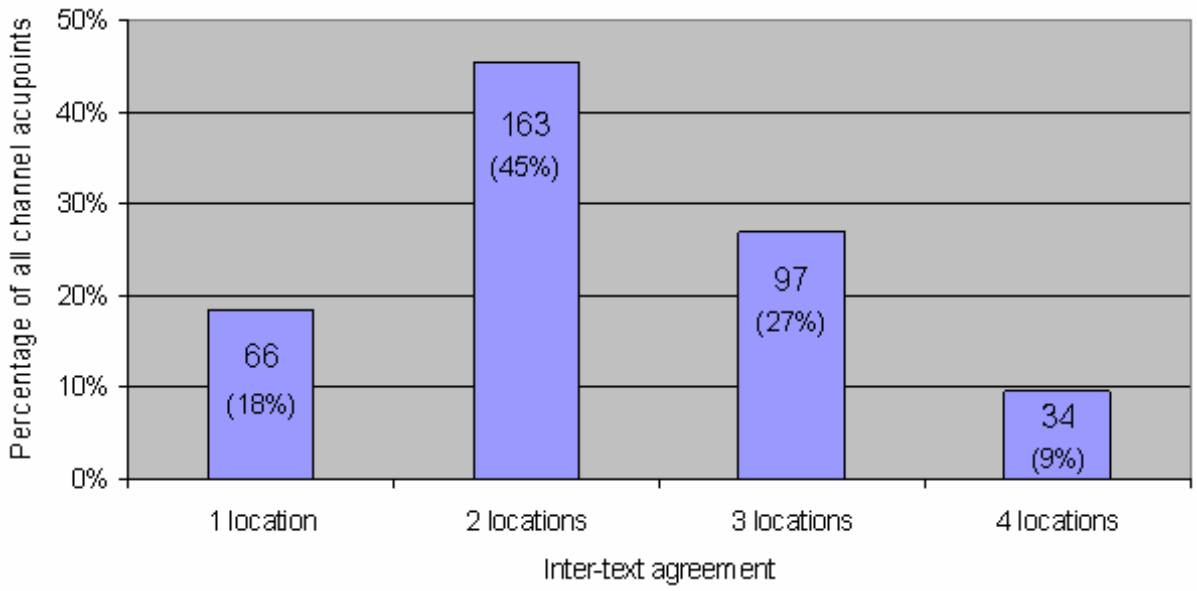

Figure 4.2 Summarised results of agreement on acupoint location descriptions between texts.

Only 18% of acupoints were described as being in the same location in each text (Figure 4.2). Most acupoints (45%) were described in two different locations. Therefore 294 (82%) of the 361 channels acupoints were described in more than one location.

Discussion

These results raise the problem of determining whether an unsuccessful treatment stemmed from the prescribed acupoints being ineffective for a given condition, or from the failure to correctly locate the acupoint. As no research has yet established which location is correct when multiple locations are listed, acupuncturists are most likely to adhere to the locations first taught to them. This does not assist the lay researcher (ie those researchers without any adequate education in acupuncture), who must trust the book or advice received. Unfortunately for reviewers of acupuncture research, fewer than 25% of the papers surveyed reported which text was used.

Survey of published research

Survey methodology

A total of 1365 clinical research papers using acupuncture were identified from the online journal databases Biological Abstracts, CINAHL, Current Contents, and Medline using the keywords “acupuncture”, “electroacupuncture”, “electro-acupuncture”, “acupoint”, and “acupoints”. These databases were accessed through the Ovid network via the library of the University of Technology, Sydney (UTS).

The sample was reduced to 151 papers through the application of the following search limits:

- Published between 1995 and 2000 inclusive
- Only clinical research on humans was included (eg all experimental research, research primarily conducted on animal models, case studies and retrospective studies were excluded)

- Any research involving the so-called ‘microsystems’ of acupuncture (eg auricular, hand, scalp, and philtrum microsystems of acupuncture) was excluded
- Only papers using ‘traditional’ acupoints were included (ie only papers describing stimulation of the 361 channel acupoints were included)
- Only papers mainly concerned with acupuncture were included (ie papers which included acupuncture as an auxiliary treatment were excluded)
- Published in English

Acupoints were only recorded in the event that they were needled. Acupoints stimulated by other means (eg moxibustion or other thermal treatment, laser, pressure, magnetism, etc) were excluded from the prescriptions recorded for each paper.

Survey results

Data were compiled using Microsoft® Excel, and analysed and graphed using Statistica®. Figure 4.1 illustrates the top 20 frequencies of prescribed acupoints in contemporary research papers. This set comprised 24 acupoints which made up 59.1 % of the total surveyed prescription content.

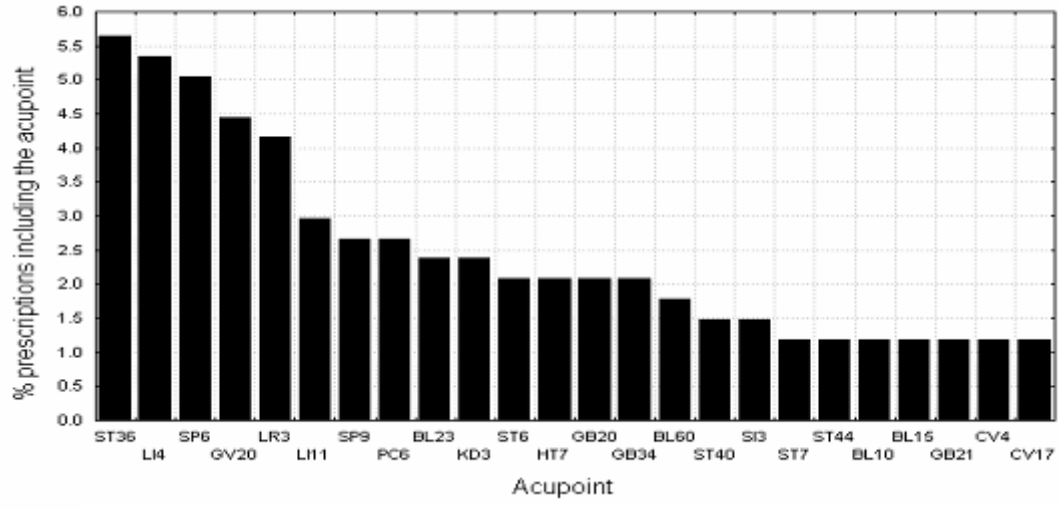

Figure 4.3 The 20 frequencies of prescribed acupoints in the surveyed research papers.

Variability in acupoint location descriptions

Selected acupuncture texts

The five most frequently prescribed acupoints identified in the survey have been used in the analysis of potential effects of the inter-text variability. The following seven acupuncture texts were surveyed:

1. Baker and Deadman (2000),
2. Ellis et al (1989),
3. Lade (1989),
4. Mi (1994),
5. O'Connor and Bensky (1981),
6. Rogers and Rogers (1989), and
7. Shandong Medical College (1988).

Four of the seven texts are considered contemporary TCM texts (Rogers and Rogers, Lade, Baker and Deadman, and Shandong Medical College). One of the texts is an original TCM text (O'Connor and Bensky), and two are classical (ie pre TCM) texts (Mi, Ellis et al).

While this is, by no measure, an authoritative list of texts containing acupoint location descriptions, these books were selected to show the difference within and between the three categories of reference texts. The differentiation between TCM and classical is on the basis that the TCM texts draw on knowledge from a time when the Chinese authorities were actively trying to standardise acupuncture theory and practice; the resultant school is known as Traditional Chinese Medicine. The classical texts contain knowledge of greater antiquity and less scientific rigor. The contemporary TCM texts are interpretations of original TCM knowledge, while the original TCM text is a translation of the Shanghai College of Traditional Medicine syllabus created to define TCM.

Each acupoint discussed in this section is shown on an anatomical photograph. Nearby anatomical structures and landmarks are highlighted, as are nearby acupoints. The point or area described by each text is shown by a blue icon containing a 'site' number. Authors with a common location description for a given acupoint will share a site number on that acupoint's diagram. Nearby acupoints are shown by yellow circles (the locations of the nearby acupoints are sourced only from Rogers and Rogers 1989) and are marked with the abbreviation of the acupoint.

Descriptions of Stomach 36 (ST36)

Table 4.2 lists the acupoint location described by each surveyed text for ST36.

Source	Site	Description
Baker and Deadman (2000)	1	"Below the knee, 3 cun inferior to Dubi ST-35, one fingerbreadth lateral to the anterior crest of the tibia." (ST-36.pdf)
Ellis et al (1989)	2	"Three body inches below the knee, on the outer side of the shinbone and in the inner side of the big sinew." (p 51)
Lade (1989)	3	"…3 units inferior to S-35, 1 unit lateral to the anterior crest of the tibia." (p 72)
Mi (1994)	2	"…three *cun* below the knee on the lateral border of the tibia." (p 191)
O'Connor and Bensky (1981)	1	"On the lower leg, 3 units below the lateral 'eye' of the knee, approximately 1 finger width lateral to the tibia." (p 271)
Rogers and Rogers (1989)	4	"3 *cun* below ST 35…the point is one finger breadth lateral and inferior to its [the tibial tuberosity] lower edge." (p 35)
Shandong Medical College (1988)	1	"3 *cun* below Pt. Dubi [ST35], one finger width lateral to the crista anterior tibiae." (p 17)

Table 4.2 Surveyed acupoint location descriptions for ST36.

Figure 4.4 shows the variance in descriptions between the surveyed texts. Given the prominence of the adjacent tibial tuberosity, it is unlikely that significant practitioner variance would result when locating this acupoint. It is unlikely then that any adjacent acupoint, Gallbladder 34 (GB34) in this instance, would be erroneously stimulated. As the anatomy beneath each of the acupoint locations is common, it is unlikely that any difference in physiological effect would occur when needling each location.

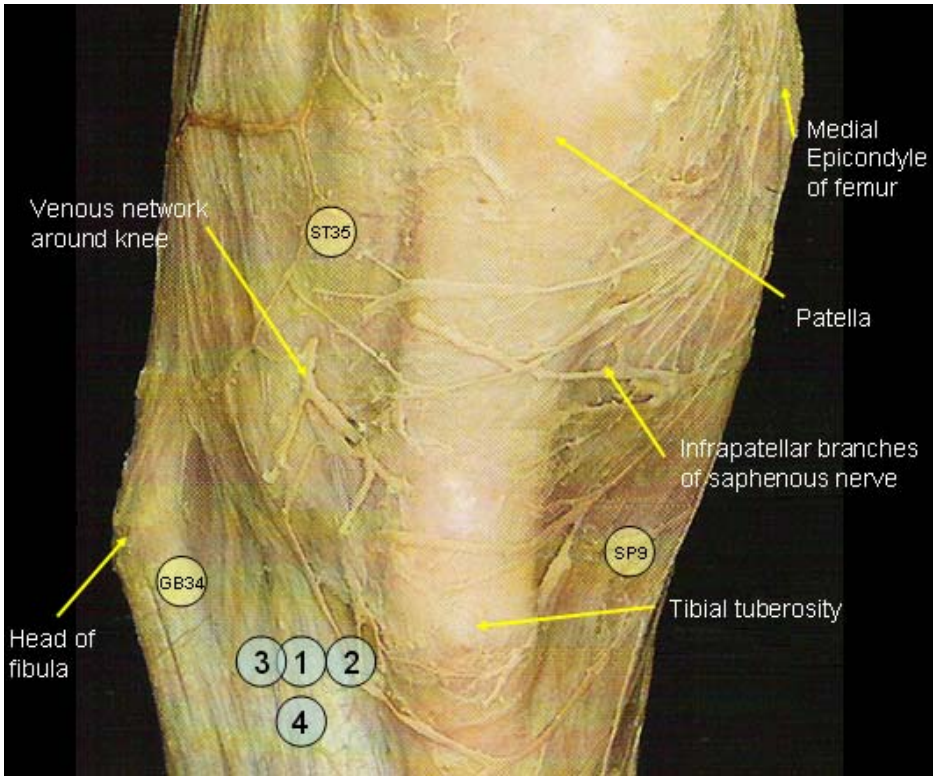

Figure 4.4 ST36 with nearby acupoints and anatomical structures.

Descriptions of Large Intestine 4 (LI4)

Table 4.3 lists the acupoint location described by each surveyed text for LI4.

Source	Site	Description
Baker and Deadman (2000)	1	"On the dorsum of the hand, between the first and second metacarpal bones, at the midpoint of the second metacarpal bone and close to its radial border." (LI-4.pdf)
Ellis et al (1989)	2	"In the depression where the index finger and the thumb bones part." (p 39)
Lade (1989)	2	"…between the first and second metacarpals which form a depression…when the thumb is abducted." (p 40)
Mi (1994)	2	"…at the articulation of the forking (metacarpal) bones of the thumb and index fingers." (p 178)
O'Connor and Bensky (1981)	3	"…slightly to the index finger side of the area between the 1st and 2nd metacarpal bones." (p 232)
Rogers and Rogers (1989)	1	"On the dorsum of the hand in the middle of the 2nd metacarpal on the lateral side (thumb side)." (p 12)
Shandong Medical College (1988)	1	"On the middle point of the os metacarpale II, on the prominence of the 1st musculus inter ossei dorsales slightly towards the side of the index [finger]." (p 11)

Table 4.3 Surveyed acupoint location descriptions for LI4.

Figure 4.5 displays the variance in descriptions between the surveyed texts. As with ST36, the proximity of obvious anatomical landmarks removes the need for any of the location methods

studied in this thesis. More concerning are the differences between acupoint locations described in the surveyed texts. Again while the local anatomy is more than likely to prevent nearby acupoints, namely Large Intestine 3 (LI3) and 5 (LI5) in this case, from being mistakenly needled, there is no guarantee that the structures stimulated at site #1 will be the same as those at site #2 or #3.

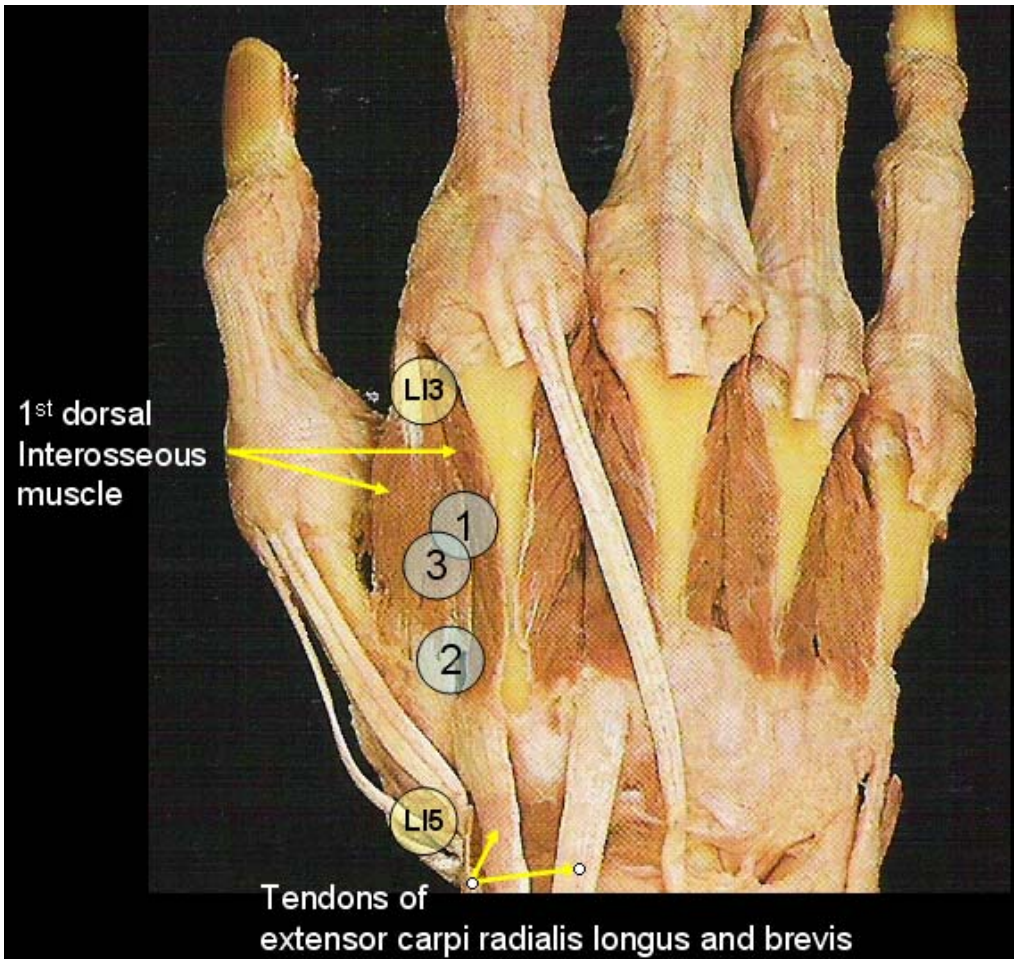

Figure 4.5 LI4 with nearby acupoints and anatomical structures.

Descriptions of Spleen 6 (SP6)

Table 4.4 lists the location descriptions reported for SP6.

Source	Site	Description
Baker and Deadman (2000)	1	"On the medial side of the lower leg, 3 *cun* superior to the prominence of the medial malleolus, in a depression close to the medial crest of the tibia."
Ellis et al (1989)	2	"In the depression beneath the bone, three inches above the tip of the (inner) anklebone." (p 105)
Lade (1989)	2	"…3 units directly superior to the vertex of the medial malleolus on the posterior border of the tibia." (p 91)
Mi (1994)	3	"…in a depression on the border of the lower bone (ie the tibia…) three cun above the medial malleolus." (p 184)
O'Connor and Bensky (1981)	4	"At the posterior margin of the tibia, 3 units directly above the medial malleolus of the ankle." (p 287)
Rogers and Rogers (1989)	2	"On the anterior/medial aspect of the leg, 3 *cun* above the 'tip' (medial extremity) of the medial malleolus, just posterior to the border of the tibia." (p 51)
Shandong Medical College (1988)	4	"3 cun above the highest point of the malleolus medialis at the posterior border of the tibia." (p 21)

Table 4.4 Surveyed acupoint location descriptions for SP6.

Figure 4.6 displays the variance in descriptions between the surveyed texts. In contrast with the first two acupoints examined in this chapter (ST36 and LI4), finding SP6 requires the use of a location method. While the presence of the tibia serves to reduce error along the X-axis, there is no suitable landmark to control error along the Y-axis.

The variability between the surveyed location descriptions is then emphasised by any error introduced by the location method chosen is. The differences can be summarised as:

1. whether SP6 is located at the medial or posterior border of the tibia, and/or
2. whether SP6 is 3 *cun* superior to the proximal border of the medial malleolus or to the medial extremity of the medial malleolus.

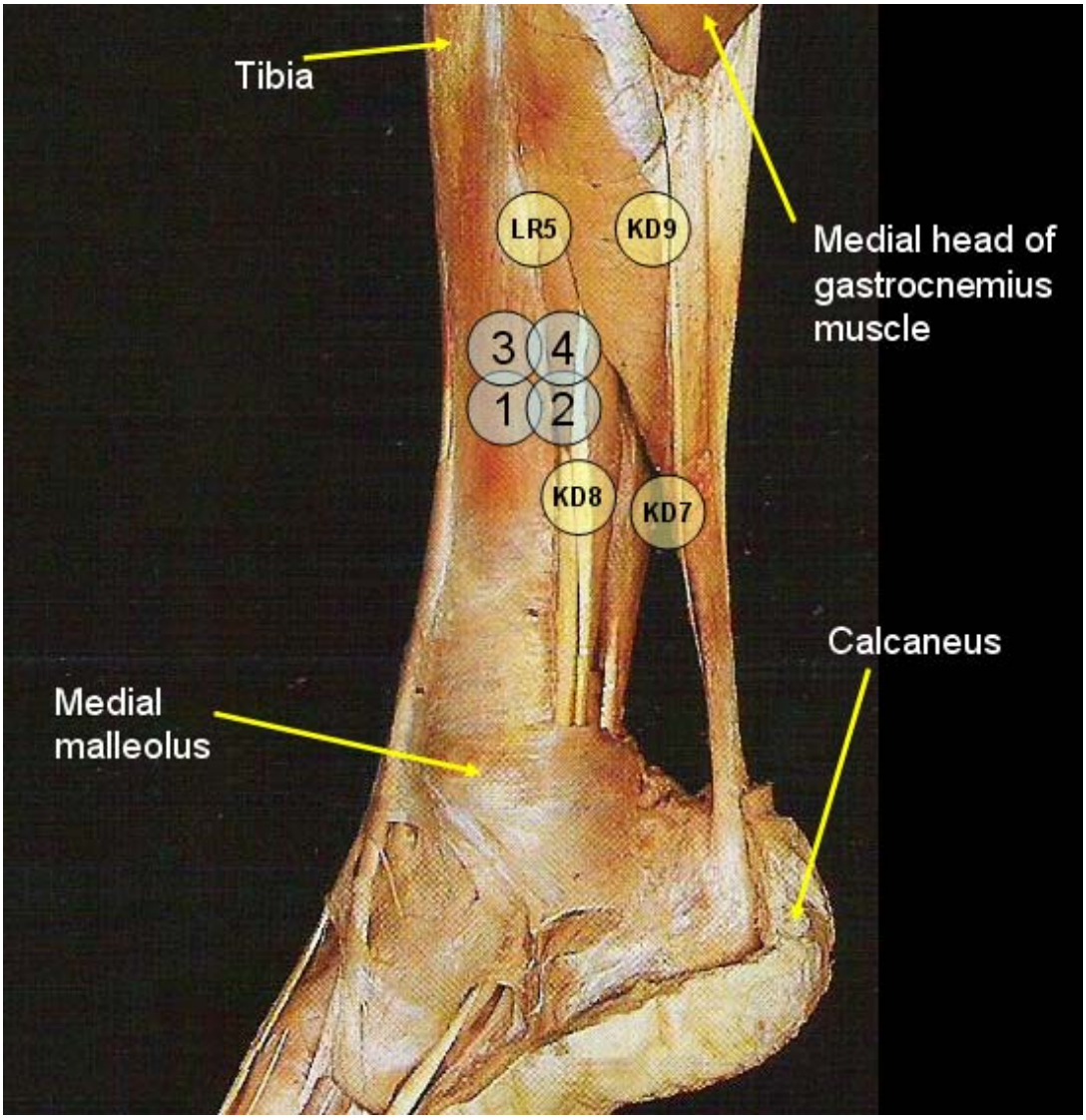

Figure 4.6 SP6 with nearby acupoints and anatomical structures.

The underlying anatomy in the region of SP6 is complex; a number of substantial nervous and vascular structures are present. The relatively small distance between the indicated sites for SP6 introduces the risk of different anatomical structures being stimulated in different studies.

Descriptions of Governor Vessel 20 (GV20)

Table 4.5 lists the location descriptions reported for GV20.

Source	Site	Description
Baker and Deadman (2000)	1	"At the vertex on the midline, in the depression 5 *cun* posterior to the anterior hairline and 7 *cun* superior to the posterior hairline. This point may also be measured as 8 *cun* posterior to the glabella and 6 *cun* superior to the external occipital protuberance." (DU-20.pdf)
Ellis et al (1989)	1	"One inch and five *fen* directly above…GV-19, in the depression that is in line with the apex of the ear." (p 344)
Lade (1989)	2	"…on the midline of the head, halfway between the frontal hairline and the vertex of the external occipital protuberance." (p 288)
Mi (1994)	1	"…one *cun* five *fen* behind [GV 19] at the crown at the epicentre of hair (growth) in a depression as large as the tip of a finger." (p 131)
O'Connor and Bensky (1981)	3	"At the intersection of the median line at the vertex of the head with a line drawn from the tip of one ear to the other." (p 141)
Rogers and Rogers (1989)	1	"7 *cun* superior to the posterior hairline and 5 *cun* posterior to the anterior hairline on the midline of the head and halfway on a line connecting the apex of both ears." (p 204)
Shandong Medical College (1988)	3	"At the junction between the line connecting the apexes of both ears and the top point of the sutura sagittalis." (p 59)

Table 4.5 Surveyed acupoint location descriptions for GV20.

Figure 4.7 shows the extent of variability which can exist between references when few or no anatomical structures are near the acupoint. The alternating pink and green boxes represent one *cun* measurements from the glabella to the external occipital protuberance (a distance of 12 *cun* according to Rogers and Rogers 1989). Site #1 is shared by four of the references including Baker and Deadman (2000). However the latter reference contains two descriptions, only one of which may be correct.

The first, "At the vertex on the midline, in the depression 5 *cun* posterior to the anterior hairline and 7 *cun* superior to the posterior hairline" shares the description provided by other references which place GV20 at site #1. However the second half of the description, "This point may also be measured as 8 *cun* posterior to the glabella and 6 *cun* superior to the external occipital protuberance" contains an error of mathematics. Baker and Deadman (2000) in one instance claim

the distance from the glabella to the posterior hairline is 15 *cun*, and the distance from the glabella to the anterior hairline is 3 *cun*. Their first half of the description for the location of GV20 establishes that the distance from the anterior hairline to the posterior hairline is 12 *cun*. Therefore the second half of their description for GV20 requires that the posterior hairline is only one *cun* inferior to the occipital protuberance. This disagrees with other authors (such as Rogers and Rogers 1989) citing the distance as 3 *cun*. Such an error in the description is of course likely to create confusion and result in an incorrect positioning of the needle when applied by a lay person and probably when applied by an acupuncturist. A lay person in regards to TCM includes practitioners and researchers not trained in TCM theory.

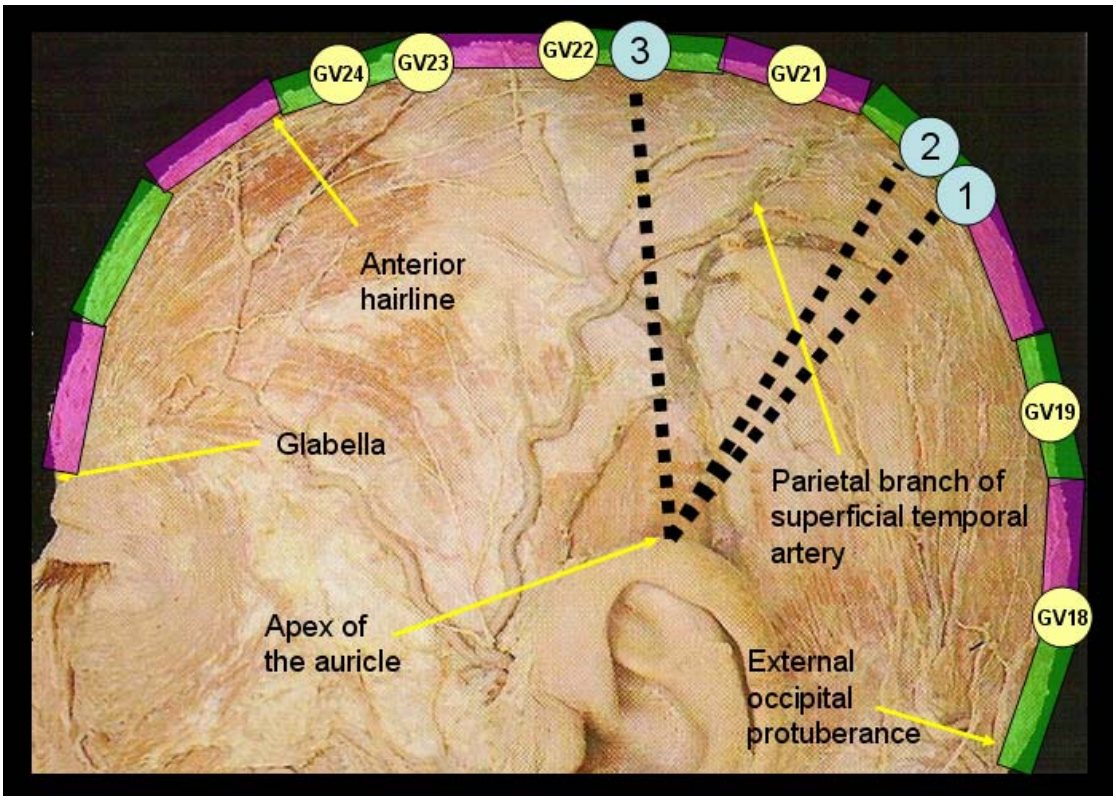

Figure 4.7 GV20 with nearby acupoints and anatomical structures.

The description given for GV20 by Ellis et al (1989) requires a measurement be taken from another acupoint (GV19). The description given for GV19 then refers to the distance from the position of GV18. This pattern continues until the description of GV16 is given, and a reference made to a nearby anatomical landmark (the external occipital protuberance). This method of describing

acupoint descriptions, often used by reference texts (eg Rogers and Rogers 1989), amplifies the error of any method used as an error can be made at each iteration of locating an acupoint. In this instance four acupoints need to be located before the position of GV20 is found.

Lade (1989) presents a slightly different position from site #1. The most obvious difference in underlying anatomy is the greater proximity of site #2 to the parietal branch of superficial temporal artery, although there is no evidence that this structure is involved in the physiology of this acupoint.

The difference between sites #1 and #2, and the description of site #3 given by the O'Connor and Bensky (1981) and Shandong Medical College (1988) texts, is particularly pronounced. The site #3 descriptions rely correct measurement of the intersection of the midsagittal line over the head and a line drawn between the apex of each ear. While other descriptions surveyed included this description, they also gave landmarks such as the hairlines, glabella and external occipital protuberance to guide location. The dashed lines in Figure 4.7 show how a line drawn between the apex of each ear can be located in a number of places. The line drawn between the apex of each ear can be placed at any point superior to the auricles, so a measurement from another landmark is required. The descriptions for site #3 provide only one additional detail, that is that the acupoint is at the vertex of the head. This extra detail does not point specifically to one spot on the head, however, and is therefore not helpful in locating the acupoint. If site #3 is used for GV20, this is then likely to affect the position of other acupoints, such as GV21 through GV23, which are typically described as a distance from GV20. While the difference in treatment effect of locating GV20 at site #3 as opposed to site #1 or site #2 is unknown, there is no reason to believe the effects would be equivalent, and therefore an uncontrolled extraneous variable is introduced into the analysis.

Descriptions of Liver 3 (LR3)

Table 4.6 lists the location descriptions reported for LR3.

Source	Site	Description
Baker and Deadman (2000)	1	"On the dorsum of the foot, in the hollow distal to the junction of the first and second metatarsal bones." (LIV-3.pdf)
Ellis et al (1989)	2	"One and a half to two inches below the base of the great toe, in the depression where the pulsating vessel can be felt." (p 293)
Lade (1989)	1	"…in the depression distal to the junction of the first and second metatarsal bones." (p 242)
Mi (1994)	1/3	"…in a depression either two *cun* or one *cun* and five *fen* proximal to the base joint of the phalanx of the big toe." (p 186)
O'Connor and Bensky (1981)	1/3	"On the foot, 1.5-2 units above the web between the first and second toes." (p 292)
Rogers and Rogers (1989)	4	"On the dorsum of the foot in the angle formed by the 1st and 2nd metatarsals, just anterior to the articulation with the 1st and 2nd cuneiforms." (p 174)
Shandong Medical College (1988)	4	"On the dorsum of the foot between the ossa metatasale I and II, in the depression posterior to the articulatio metatarso-phalangae." (p 56)

Table 4.6 Surveyed acupoint location descriptions for LR3.

The descriptions in the surveyed texts differ sufficiently (within and between texts) to create the variability shown in Figure 4.8. While four of the texts describing site #1 mark the location in reference to a palpable depression distal to the articulation of the 1st and 2nd metacarpals, two of those four texts state the distance from the articulation to LR3 is 1.5-2 *cun*. Although this is a small distance, the difference in underlying anatomy in this area can be pronounced. For example site #1 is closer to the medial dorsal cutaneous nerves than is site #3 – yet the distance between the sites is only 5 *fen* (0.5 *cun*). (This is why two texts are shown in Table 4.7 as belonging to site #1/#3).

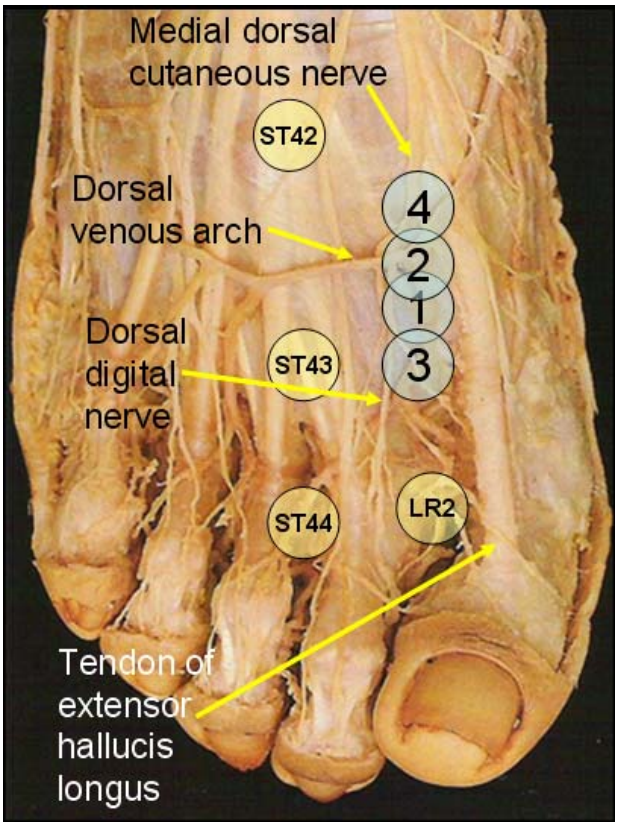

Figure 4.8 LR3 with nearby acupoints and anatomical structures.

Site #2 differs from the other three sites due to its location over the anastomosis of the deep plantar branch of the dorsalis pedis artery with the plantar arch, allowing a pulse to be palpated. The role of these structures in the physiology of LR3 is not known, and consequently the effect of needling them cannot be controlled for in a trial. Therefore the differences in underlying structure introduce uncontrolled extraneous variables.

Summary of variability

These case studies of the five most commonly prescribed acupoints in the surveyed research papers demonstrate the variability between texts. The degree of variability was far larger in the examination of GV20 than the other four acupoints. However given the presently poor understanding of the anatomical make-up of an acupoint, it the effect of even a small variability is not know. Therefore, a small variability may result in a substantial difference in treatments effects.

Chapter 5. Examination of pressure sensitivity of acupoints

Introduction

Two methods of acupoint location that do not rely on using the *cun* unit are palpation and electric detection (measuring variations in the electrical resistance of the skin). Electric detection has already been discussed in Chapter 3 and found to be of questionable value. While palpation might be a useful adjunct method when used to identify landmarks described in a location description, its value as the sole method of acupoint location is also doubtful. This was illustrated in a survey by Aird and Coyle (1999) of final (fourth) year acupuncture students at UTS. The students were asked to list the properties that could be palpated, if any, in order to locate an acupoint. The results showed wide disagreement, with properties ranging from tenderness, to a change in temperature, and even to 'feeling the energy'.

Tenderness is a quality discussed in TCM theory to indicate the presence and position of a particular class of acupoint known as the *ahshi* point. *Ahshi* points are those points on the body where localised pain appears spontaneously. This is thought to be in relation to musculoskeletal problems or disease (Chaitow 1987).

Ahshi points are generally unrelated to the 361 acupoints located on channels or meridians. However tenderness was the quality most commonly felt for by the advanced students, despite the survey specifically using channel acupoints as case studies. Furthermore, it was observed during the survey that students typically tested for tenderness by pushing with increasing force at the site chosen by the student until the patient indicated pain. The following study was carried out to examine the appropriateness of the students' belief that tenderness is an inherent quality of an acupoint.

Palpation study methodology

The sample

Twenty subjects (volunteers) were examined. All subjects were right-handed. The subjects included 12 men and eight women, ages ranged from 18 through to 55 years.

The test

Each subject lay supine while pressure was applied to the acupoints ST36, SP6, Spleen 9 (SP9) and PC6. The identical test was applied to nearby control points. The order of application of the test was randomised using a random number generator. The centres of the control points for ST36, SP6 and SP9 were all 20 mm posterior to the centres of the respective acupoints, while the centre of the control point for PC6 was 20 mm proximal to the centre of the PC6. These acupoints were selected because they are in the top eight most prescribed acupoints identified in the survey discussed in Chapter 4, and because all can be located without the use of a location method (ie the proximity of each acupoint to an anatomical landmark allows each to be located by its description alone) thus reducing location errors. The instrument used to apply and measure the pressure was an algometer (Activator Methods Inc., Phoenix AZ, USA, (602) 224-0220) with capacity of 10 kg (20 Lb) and increments of 100 g (0.25 Lb). An algometer (shown in Figure 5.1) is a device used to give readings of pressure applied to a localised area. It is most commonly used in pain studies.

Application of the algometer

The algometer is tipped with a flat, disc-like rubber end. It prevents the algometer from moving laterally when applied to the skin and prevents the metal edges of the tip from causing pain. The test was applied at a slow rate (approximately 1 kg/second) of increasing pressure for each acupoint and each subject. On each application care was taken to ensure the algometer was applied at a perpendicular orientation to the target point on the subject and the rubber tip was flat to the skin. Pressure was increased until the subject indicated pain.

Figure 5.1 An algometer similar to the one used in this study.

Palpation study results

Raw data

Table 5.1 shows the raw data from by the study. Each score describes the amount of pressure applied (in kilograms) before the subject indicated pain. The letter 'C' after an acupoint name (for example, "ST36 C" indicates the control point for that acupoint.

Subject	ST36	ST36 C	SP6	SP6 C	SP9	SP9 C	PC6	PC6 C
1	7.3	6.8	1.7	2	2.1	2.3	5.6	5.6
2	7.8	8.4	6.8	8	6.6	5.5	5.4	5.6
3	6.3	4.7	6.3	8.8	3.7	3.4	4	5.6
4	8.3	7.6	5.1	4.1	2.9	3.4	5.5	5.5
5	4.9	5.8	5.8	6.8	4.7	4.9	5.9	4.2
6	7.4	5.7	6.2	3.8	7.3	8.2	8.1	8.6
7	7.7	9.1	8.5	6.6	6.2	6.4	10	9.2
8	5.1	6.7	4.9	6.4	3.9	2.8	5.5	5.4
9	6	7.1	5.2	5	4.7	4.9	6.8	6.6
10	5.9	6.9	6.6	7	5.5	5.4	6.1	6
11	7.5	8.6	4.5	5.6	4.9	5.5	4.6	4.8
12	4.8	5.9	6.4	8.1	4.3	6	5	6.6
13	5.1	5.3	4.8	6.9	5.9	4.5	4.9	5
14	5.6	6.5	9.6	8.5	7.9	6.3	5.9	6.7
15	8.8	8.2	4.7	5.8	3.9	2.6	5.2	5.8
16	9.8	10	8.5	8.4	7.6	8.3	9	8.9
17	8	7.9	3.1	2.1	4.9	4.8	8.3	6.3
18	8	7.7	5.7	6.9	6.3	5	5.8	5.2
19	10	9.5	8.6	7.8	5.3	5.2	6.1	6.5
20	5.9	3.9	6.2	4.9	4.5	5.9	6.2	7.1

Table 5.1 Raw data of pressure thresholds (kg) collected from 20 subjects.

Analysis

Two-tailed, paired t-tests were carried out to measure any difference between each acupoint and its control point in terms of pressure threshold. No statistically significant difference was found between any of the acupoints tested and the related control points. The results for ST36 are presented below in Figure 5.2. No difference was found between the pressure tolerated on ST36 to that tolerated on the control point ($p = 0.67$).

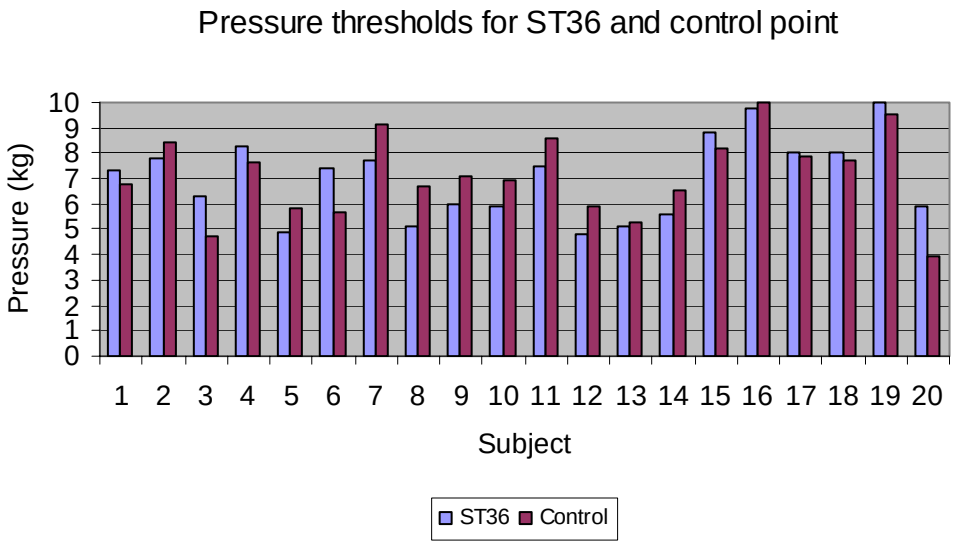

Figure 5.2 Results of the algometer test on ST36 and a control point.

The results for SP6 are presented below in Figure 5.3. No statistically significant difference was found between the pressure tolerated on SP6 to that tolerated on the control point ($p = 0.50$).

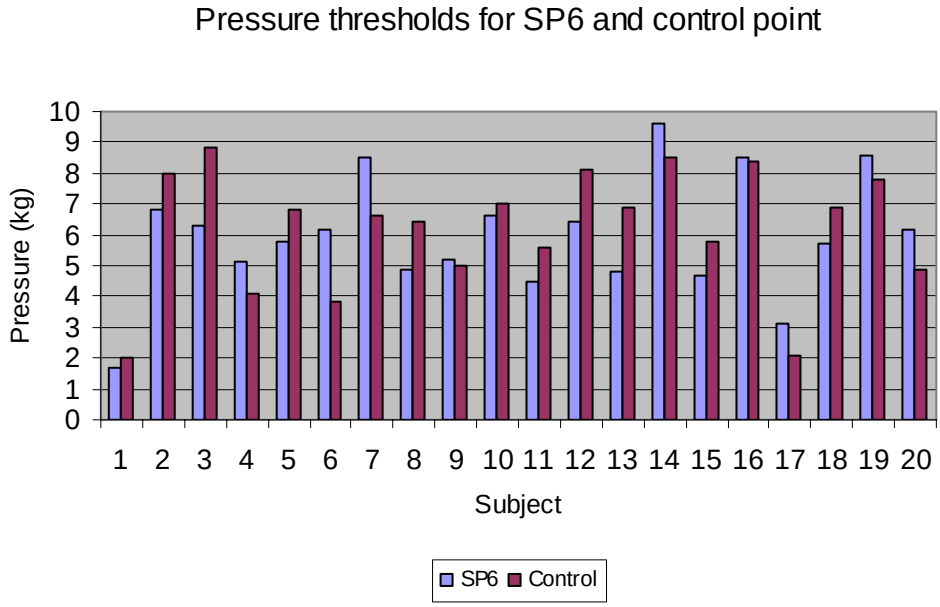

Figure 5.3 Results of the algometer test on SP6 and a control point.

The results for SP9 are presented below in Figure 5.4. No statistically significant difference was found between the pressure tolerated on SP9 to that tolerated on the control point ($p = 0.68$).

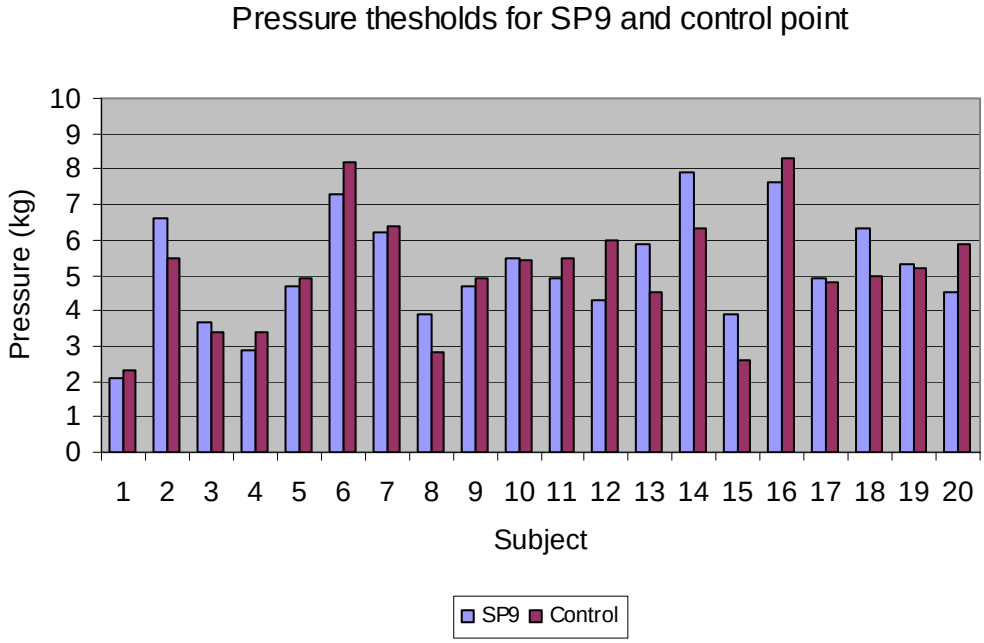

Figure 5.4 Results of the algometer test on SP9 and a control point.

The results for PC6 are presented below in Figure 5.5. No statistically significant difference was found between the pressure tolerated on PC6 to that tolerated on the control point ($p = 0.75$).

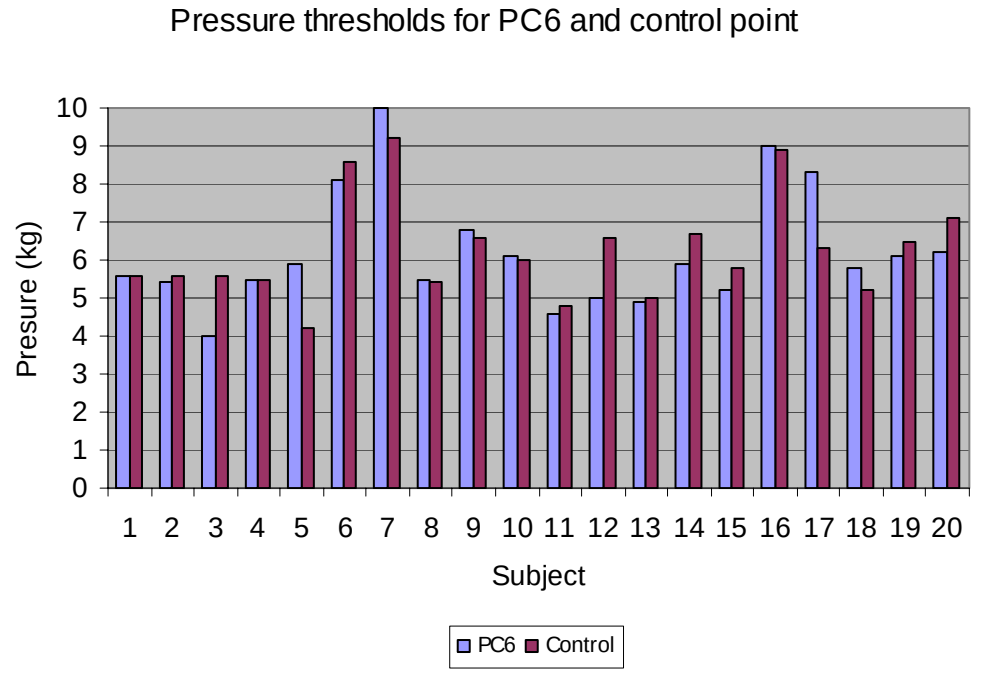

Figure 5.5 Results of the algometer test on PC6 and a control point.

Palpation study discussion

The results for the palpation study showed that four of the most commonly prescribed acupoints identified in the survey reported in Chapter 4, cannot be reliably located by testing for tenderness. These results do not preclude the use of palpation for pain in the case of *ahshi* points as described above, nor for the location of acupoints by anatomical feature (for example a depression or suture). However these results do show that the beliefs of the fourth-year acupuncture students surveyed are unfounded. An acupoint cannot be identified from an control point using the palpation method. It should be noted that all subjects reported their states of health as normal. This study did not, therefore, knowingly measure the acupoints in any disease state.

Chapter 6. Discussion

The aim of this thesis was to identify and measure variability of precision within four acupoint location methods, and to compare the variability of precision between the same methods. The acupoint location methods tested were the directional method, the proportional method, the elastic method, and the ruler method.

This study found significant variability of precision in each of the four acupoint location methods. Specifically, the surface area of an acupoint would need to be between 2.9 cm^2 (for the ruler method) and 12.7 cm^2 (for the directional method) if 95% of attempts at locating the acupoint were to be successful. The consequence of these findings is that any acupuncture study which has employed these common methods, or derivatives of them, may have converted the variability of locating the acupoints into a variability of treatment effects. For example, a treatment effect may be different if the acupoint is missed, if the acupoint is not located in the same spot every time, or if a nearby acupoint is stimulated by mistake. (Of course if no treatment effect exists, there will be no effect from variability in locating the acupoint!) This finding has both positive and negative perspectives for acupuncture – **while these methods of locating acupoints are imprecise, the effect of these flawed methods may provide an alternative explanation for some of the variability seen in acupuncture trials, or even instances when no treatment effect was found at all.** Given a precise method of acupoint location, researchers may report quite different results when attempting to replicate earlier results obtained using the imprecise methods of location.

In the study of variability in and between the four methods of acupoint location, subjects were also questioned on the useability and their perceptions of each of the methods. Most subjects rated the directional and proportional methods as either ‘very comfortable’ or ‘comfortable’. Almost half of the ratings for the elastic and ruler methods were for ‘uncomfortable’. The remaining subjects were generally evenly divided between ‘comfortable’ and ‘very uncomfortable’. The elastic and ruler

methods were the cause of all of the concerns about perceived professionalism and 86% of concerns about the degree of comfort in a clinical situation. Further development of the more precise elastic and ruler methods is required to allay the subjects' concerns, and encourage use of these methods in preference to the directional and proportional methods. **It should be of concern to acupuncture educators that students perceive the most imprecise methods of locating acupoints (directional and proportional methods) as more comfortable than the significantly more precise methods (elastic and ruler methods). Similarly concerning is the finding that students perceive the elastic and ruler methods as appearing unscientific to patients in a clinical setting.**

Subjects of one of the experiments carried out in this research indicated that palpation was useful to pinpoint acupoints. The subjects indicated that acupoints are more sensitive to pressure than surrounding tissue. This study measured the sensitivity to pressure of acupoints, and of the tissue surrounding the same acupoints. No significant differences were found that acupoints are more sensitive to pressure than surrounding tissue. **The application of pressure cannot be used to locate or even verify the location of an acupoint in a healthy subject.** It was not tested whether an acupoint's sensitivity to pressure varied over time or in disease states. **It should be noted, however, that the use of palpation to identify attributes other than pressure sensitivity** (such as concavity, for example) **was not tested and other such properties may exist.**

The electrical resistance of the skin has been reported in the literature to be different over an acupoint, compared to over the surrounding tissue. This method was discounted by the present study after an extensive literature reported a wide range of extraneous variables in studies reporting the effect. For example, factors such as physical characteristics of the electrode, pressure of application, physical characteristics of the skin, and time of day, were reported as affecting the result of the tests. There is therefore no reliable evidence that the electrical resistance of an acupoint

is different to the resistance of surrounding tissue. **Therefore measurements of the electrical resistance of the skin cannot assist in locating an acupoint.**

Reviews of relevant literature found the central issue of precise acupoint location has neither been considered nor reported in relevant research trials. **Important oversights in published acupuncture research include the failure to describe the locations of acupoints studied, the failure to describe the methods used to locate acupoints, and the failure to provide the bibliographic details of any acupoint location texts referenced.**

Research by Coyle et al (2000) and Aird et al (2000) represent the only two relevant publications found which did address the issue of acupoint location methods. Aird and colleagues examined the accuracy of two methods also tested in the current study: the directional and proportional methods. They demonstrated the poor reliability of both methods, whereby repeated attempts to locate the study's target acupoint actually overlapped the coordinates of nearby acupoints. Coyle and colleagues demonstrated experimentally that the *cun* unit is unreliable when measuring a distance from a landmark to the acupoint (ie the directional method of acupoint location).

The STRICTA statement was developed and published by leading acupuncture researchers, in an effort to address the widely reported methodological flaws that are seemingly inevitable in any acupuncture trial, and in response to a similar move to improve research methods application in mainstream medicine research. Although this statement specifically targets issues confined to acupuncture research (such as depth of needle insertion, needle dimensions and style of acupuncture), it contains no guidance for researchers to improve the application or reporting of acupoint location methods. Nor did the authors of STRICTA address the consequences of using unreliable and/or inaccurate acupoint location methods. **While the most likely consequences of imprecise acupoint location are variability in treatment effects, there is also the potential for**

harm to patients and research subjects because of the proximity of many acupoints to vital anatomical structures.

The present research study also found that, between acupoint location texts, there exists variability in the described locations of acupoints. **In combination with the poor precision of acupoint location methods, variability in reported acupoint locations between reference texts increases the difficulty of comparing the results of acupuncture trials.**

Conclusion

According to TCM theory there are 361 acupoints located on channels or meridians on the human body (Rogers and Rogers 1989). Just over half (54%) of these acupoints can only be found by measuring a prescribed distance from an anatomical landmark or nearby acupoint to the target acupoint. Measurements between a landmark and the target acupoint are made using the methods of locating an acupoint examined in the present research, namely the directional, proportional, elastic and ruler methods. The author of this study is not aware of any methods of acupoint location which are fundamentally different from those methods examined. **Consequently, it is concluded that acupoints cannot be precisely located using the methods currently taught to students, practised by acupuncturists, and applied by researchers, and therefore that most acupoints are not precisely located.**

This finding has significant implications for the practice of acupuncture, be it in clinical practice or experimental research. Acupuncture research, despite having been published for some 40 years now, has not adequately addressed this fundamental aspect of the practice. Acupoint location descriptions and methods are vital considerations in research and practice, yet to date no standards have been set. The appropriate education of researchers in both acupuncture and research methods theory is critical to the ability to produce useful results. Acupuncture research trials will continue to

suffer poor internal and/or external validity until practices are standardised, researchers are appropriately trained, and publications detail how variables, such as the method of acupoint location, were controlled. Until such time acupuncture will continue to languor in the realm of ‘alternative’ medicine, or, at worst, irresponsible quackery. **The alternative is to redirect research efforts toward understanding the fundamental theories and practices of acupuncture, including the ability to precisely locate acupoints.**

Chapter 7. Future directions for research

This study's results have demonstrated the lack of precision resulting from commonly used acupoint location techniques. Given that the stimulation of acupoints is fundamental to the practice of acupuncture, future research should be directed towards improving the precision of acupoint locating techniques, with a view to improving the practice of acupuncture. This can be seen as a three step process, starting with measuring the required precision, then developing a more precise method, and finally identifying a procedure to measure whether an acupoint has been correctly located. This chapter proposes a research study to meet the first step: measuring the required precision.

The required precision of an acupoint locating technique can be measured by observing a physiological reaction which:

1. varies quantifiably between stimulation of an acupoint and stimulation of 'neutral' tissue,
2. occurs immediately upon stimulation, and
3. is subject to minimal or no conscious or subconscious control of the subject.

The variation in effect between an acupoint and neutral tissue will allow measurement of the surface area and depth of an acupoint, and therefore the required precision in locating the acupoint. It should not be assumed that all acupoints are equal in size, nor that the size is static. It is feasible that an acupoint may be found to be one size on a subject when healthy, and another when diseased.

The immediacy of a measurable reaction provides a more positive environment for proving causality. Causality also requires that the particular physiological reaction be carefully selected to minimise extraneous variables from consideration. For example, measurements such as heart rate can be affected by various factors such as "…mental distraction and mental stress…" (Madden and Savard 1995 p 557).

A family of physiological reactions which meet these criteria are event-related, or evoked, potentials (ERPs). ERPs are products of the central nervous system, manifest in the cerebrum, and are "…time-locked to sensory, motor, or cognitive events and provide a neurophysiological reflection of the processing of these events" (Pfefferbaum et al 1995). ERPs are measured via electrodes placed on the scalp. Important variables in the description of ERPs are:

- the size of any pronounced positive (P) or negative (N) change in the amplitude of an ERP, and
- the length of time, or latency, between stimulus and any change in the amplitude of an ERP.

For example, an ERP called the P300 (also known as the P3), is manifest as a pronounced positive change in amplitude which occurs 300 milliseconds (ranging up to 500 milliseconds) after a stimulus (Pfefferbaum et al 1995). The P300 has been identified as varying with stimulation of some acupoints, and meets the criteria listed above for a physiological reaction appropriate for the proposed research (that is it undergoes a quantifiable change immediately on stimulation and is independent to any conscious control of the subject).

Literature review

Almost all work relating to acupuncture and evoked potentials involves the investigation of the effect of acupoint stimulation on somatosensory components. The effect of acupuncture on the amplitude of the P300 component was tested at the acupoints Heart 7 (HT7) and LI4 by Abad-Alegria et al (1995a). A nonacupoint was also tested. The P300 amplitude was measured immediately after stimulation of the acupoints and continued at intervals for the following 15 minutes. Abad-Alegria et al (1995a) found that the amplitude of the P300 component was not significantly affected by stimulation of either LI4 or the nonacupoint. Stimulation of HT7, however, produced a significant effect of 30% increase over baseline at five minutes post-stimulation, increasing to 75% by the fifteen minute measurement.

The effects of acupoint stimulation and median nerve stimulation on various evoked potentials and the electroencephalogram (EEG) were compared by Xu et al (1998). When compared to the control (median nerve stimulation), acupuncture was found to cause significant effects on peak latencies and inter-peak amplitudes for somatosensory, visual, and auditory evoked potentials. In particular the P3-N3 amplitude was significantly altered by stimulation of ST36. The authors concluded that stimulation of ST36 affects the auditory pathway continuously and in a complex manner.

Research by Abad-Alegria et al (1995b) into the effect of stimulation of the acupoints HT7, LI4, and Small Intestine 3 (SI3) found that repeated acupoint stimulation results in evoked potentials whose latencies varied relative to the degree of stimulation. This work carried on from that of Yamauchi et al (1976) which had found that acupoint stimulation produced brain signals similar to the somatosensory evoked potential.

Kawashima et al (1991) investigated the effects of stimulation of the acupoints LI4, LI10 and Triple Heater 5 (TH5) on somatosensory evoked potentials. The authors found a significant suppression of P22 and P40 amplitudes.

Volf (2000) examined the effects on somatosensory evoked potentials of stimulation of the auricular acupoints ‘Wrist’ and ‘Gall Bladder’. A non-active placebo point was used as control. While stimulation of the placebo point was found to have no measurable effect, stimulation of both the ‘Wrist’ and ‘Gall bladder’ points activated the corresponding cortical somatosensory area in the same was as direct stimulation to the median nerve and T7 intercostal nerve respectively.

Conclusion

The measurement of physiological reactions to stimuli can be used to investigate a number of issues related to acupuncture practice and theory. For example, the current research study is dedicated to

the examination of techniques used to locate acupoints. If an acupoint can be shown, via measurement under controlled conditions, to produce a repeatable physiological reaction, then that reaction can be used to measure the surface dimensions of the acupoint. The resulting information will contribute to that required to report surface dimensions for acupoints. Once the surface dimensions are known, the required precision of a technique used to locate acupoints will be known. This knowledge will greatly assist future research examining improved techniques.

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