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A study of the effectiveness of acupressure in reducing spasticity in children with cerebral palsy

Monica Sampson
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A STUDY OF THE EFFECTIVENESS OF ACUPRESSURE
IN REDUCING SPASTICITY
IN CHILDREN WITH CEREBRAL PALSY

A Thesis
Presented to
The Faculty of the Department of Occupational Therapy
San Jose State University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science

By
Monica Sampson
May, 1995

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ABSTRACT

A STUDY OF THE EFFECTIVENESS OF ACUPRESSURE IN REDUCING SPASTICITY IN CHILDREN WITH CEREBRAL PALSY

by Monica Sampson

This study used a single subject ABA design to determine whether the traditional modality of acupressure would produce a reduction of muscle tone in children with cerebral palsy. The muscle tone of the frontalis muscle of five subjects was measured for ten minutes over two second intervals using an EMG biofeedback instrument two minutes before (Phase A1), five minutes during (Phase B), and three minutes after (Phase A2) the administration of acupressure.

The results of this study neither support nor refute the efficacy of acupressure as an enabling technique. Although one of the subjects showed a statistically significant decrease in muscle tone in response to the administration of acupressure, the other four subjects did not. Further research in this area needs to be conducted before definite conclusions can be drawn regarding the use of acupressure as an enabling activity and its efficacy in occupational therapy.

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"Trust in the Lord with all your heart and lean not on your own understanding; in all your ways acknowledge Him and He will make your paths straight."

Proverbs 3:5

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CHAPTER 1

INTRODUCTION

Purpose

The purpose of this study was to determine the effectiveness of stimulating specific Chinese acupressure points that reportedly alleviate spasticity (increased muscle tone) in children with cerebral palsy.

Statement of Problem

Spasticity is a muscle tone disorder that affects movement in which an increase in tone creates an imbalance between muscle groups. Spasticity is clinically seen as hypertonicity, hyperreflexia, degrees of paralysis, clonus, and weakness. As a result, spasticity interferes with the purposeful behaviors of individuals who have neurological deficits. Occupational therapists are concerned with the effort to find techniques that will aid in the reduction of hypertonicity so that their patients may more independently perform functional activities and thereby meet therapeutic goals. In some of the literature, it has been reported that acupressure may lead to relief of muscle tension headaches

due to a generalized relaxation response (Joachim, 1984; Smith, 1988; Stumbo, 1986). Since a generalized relaxation response results in a decrease in muscular tone, hypertonicity may also be reduced (Benson, 1975). Thus, the use of acupressure to reduce spasticity should be explored as a procedure which may assist in increasing the purposeful and functional activity of individuals who have spasticity (Thurston, 1986). However, considerable research still needs to be conducted in this area in order to document its effectiveness and support its use in occupational therapy.

Null Hypothesis

The null hypothesis tested in this research was:
During and after the application of acupressure, muscle tone of the frontalis muscle of children who have the diagnosis of cerebral palsy will not be significantly reduced as compared to the subject's initial electromyogram reading on the Biofeedback MicroLab.

Definitions

The following definitions were generated for this study:

Conceptual

Acupoints: In traditional Chinese medicine, there are 360 points or loci on the human body which have been identified as being "electrically discrete entities with electrical conductance greater than that of the surrounding skin" (Steiner, 1983). They are believed to be connected in a specific pattern by energy channels called meridians (Pomeranz & Stux, 1988). (See Appendix A).

Electromyographic (EMG) biofeedback: The process of monitoring subtle changes in muscle tension (minute muscle contractions measured in millivolts).

Relaxation response: A simultaneous decrease in muscle tone, heart rate, respiration rate, oxygen consumption, carbon dioxide production, respiration rate, heart rate, arterial blood lactate, pH and base excessive levels, accompanied by increases in alpha wave activity, galvanic skin responses, and skeletal blood flow (Benson, 1975).

Hypertonicity: An excess of muscle tone.

Meridian: One of fourteen discrete channels in the body, through which electromagnetic energy is thought to flow.

Muscle tone: Normal tension, level of activation, or

responsiveness to stimuli in a muscle.

Occupational performance: The ability to carry out one's life roles.

Occupational therapist: One who evaluates the self-care, work, play, and leisure time task performance skills of well and disabled clients of all ages. One who is registered nationally to practice occupational therapy.

Occupational therapy: A holistic approach to rehabilitation using purposeful activities to achieve maximum independence of function throughout the lifespan.

Spasticity: Increased tone or contractions of muscles causing stiff and awkward movements - the result of upper motor neuron lesion.

Traditional modality: folk medicine or cultural technique as opposed to a conventional modality which is mainstream western medicine.

Operational

Acupressure: The act of applying finger pressure (measured in pounds of pressure which can be verified using a scale to get a feel for the accurate amount) to precise locations on the skin called acupoints.

Acupuncture: The act of inserting needles into precise locations on the skin called acupoints and then

twirling or running a small electrical current through the needles to stimulate the acupoint.

Frontalis muscle: one of the muscles of the forehead; a good indicator of overall muscle tone and general body relaxation (Basmajian, 1989).

Initial electromyogram reading: The first two minutes of recording the subject's muscle tone of the frontalis muscle when no intervention of acupressure is given; a baseline of the subject's muscle tone.

Muscle tone of the frontalis muscle: The degree of tension or level of muscle activity as indicated by measures in millivolts (mV, or one-thousandth of a volt) of electrical activity within the muscle. These measurements will be provided by Biofeedback MicroLab software using an Apple IIe computer.

Assumptions

It was assumed that the intervention of acupressure would be the same for each of the subjects in the study. It was also assumed that the EMG biofeedback instrument would be operated in a consistent manner and that the recording electrodes would be positioned properly over the frontalis muscle. Since this study was conducted using a single subject ABA research design, it was also assumed that each

subject would serve as his/her own control.

Limitations

The limitations identified by the investigator are:

1. This study used a small sample.
2. This study used an ABA research design, which does not allow for generalization to a larger population without replication (Ottenbacher, 1984).
3. The subjects for this study were not randomly selected.
4. There was no method available to measure whether the practitioner's administration of acupressure was consistent from subject to subject.
5. The researcher attempted to control external factors, such as noise level, which may have had an influence on a subject's muscle tone, by conducting the experiment in a quiet room. However, sudden noises from the outside may have caused an increase in muscle tone.
6. The researcher was unable to control internal factors, such as the subject's emotional state, hunger, or response to a new situation which may have had an influence on the subject's muscle tone.
7. The computer may not have been marked at the exact moment that the acupressure commences, but should have been

within the two second interval that the Biofeedback MicroLab software takes the EMG readings.

Significance of the Study

The goal of this preliminary investigation was to demonstrate whether acupressure could be used effectively as an "enabling method" to reduce muscle tone. The results of this study will serve as a foundation for further investigation using a larger population. It will indicate whether research should continue to be conducted regarding acupressure as an appropriate method of therapeutic intervention for individuals with neuromuscular dysfunction.

In addition, if acupressure were to be found to be effective in reducing muscle tone, the field of occupational therapy may also benefit by employing this traditional modality in its treatment of spasticity.

CHAPTER 2

LITERATURE REVIEW

History

Acupressure originated from empirical findings that began early in Chinese history. One of the oldest recorded accounts of the use of acupressure can be found in the Nei Ching, or Yellow Emperor's Classic of Internal Medicine, which was written around the fourth century B.C. (Teeguarden, 1978). This Chinese canon of medicine explains Taoist theories on health and disease and gives practical implications for the prevention and cure of many illnesses. This text still remains the primary source of reference on the subject of acupressure.

Chinese physicians and philosophers found that the application of touch could relieve pain from an injury. The Chinese believed that an energy called Chi circulates throughout the human body. When the body is healthy, the flow of Chi proceeds unblocked and the energy is widely distributed throughout the body's energy pathways. However, when there is disease within the body, the energy within the pathways is out of balance.

According to the Nei Ching, acupuncture is 5,000 years

old, and acupressure actually predates the more invasive technique (Steiner, 1983). Teeguarden (1978) explains that acupressure was a folk art which belonged to the common people of China, from which evolved the traditional acupuncture treatment used by oriental therapists and physicians. For the interested reader, Chang (1986) has compiled a book of 119 research studies on acupuncture.

Acupressure: Acupoints and Meridians

Acupressure uses the same acupoints as does acupuncture; the difference between them is the type of stimulation directed at the acupoints. Acupressure uses a non-invasive type of stimulation, pressure exerted by the fingertips, whereas acupuncture employs the insertion and twirling of or the use of electrical stimulation through long, thin needles to stimulate the point. The effects are often variable. Much of the research on the acupoints has used acupuncture, so most of this literature review will focus on this area.

With this explanation in mind, the use of acupressure can then be defined as the application of cutaneous stimulation in the form of finger pressure to precise points on the skin called acupoints. There are over 360 acupoints which have been identified. In Chinese medicine, each of

these acupoints has a name and a number to identify its effect or location. These acupoints are connected to one another in a specific pattern by fourteen different channels known as meridians. Through each meridian flows what is believed to be a form of electromagnetic energy, which in Chinese is called Chi. When fingertip pressure is applied to a point, one can influence the flow of energy along its meridian. Finger pressure appears to relieve blockages, in addition to alleviating symptoms. This process will also facilitate the balance of energy among the fourteen meridians, which manifests itself as a state of wellness. It is similarly described by St. John (1984): "When stiffness and tension are present in muscles and joints, the flow of this bio-electrical current is blocked. Stimulating the points with fingers releases this flow, thereby loosening muscles. . . (p. 13)".

Upon closer examination, Karlsson and Reichmanis (in Steiner, 1983) have described acupoints as "electrically discrete entities with electrical conductance greater than that of the surrounding skin" (p.62). Another way to explain acupoints is that they are points along a meridian's energy pathway which offer the least resistance and are thus sensitive to stimulation. Thus, Bresler (1979) described acupoints as "neural receptors" which are located on the surface of the skin and are highly sensitive to stimulation,

whether the stimulation be from a finger or an acupuncturist's needle.

After 20 years of observation and experimentation, a German professor of Neuroanatomy named Voll found that meridians and acupoints represent:

condensations of field force which is formed by body energy that is generated from the organic systems, from the Krebs cycle and the oxidative phosphorylation of the respiratory chain carried out within the mitochondria. When this system is normal, there is a high degree of molecular orderliness and it produces highly organized, measurable energetic potentials. When there are pathological disturbances, there are definite measurable changes electrically reflected in the field force (Tsuei, 1983, p. 152).

Dr. Kim Bong-han, professor of medicine at Korea's Pyngyong University noticed that variations in the skin's electrical resistance could be traced along the meridians and that the skin cells along meridians are structurally different from other skin cells. At certain points along the meridians he found clusters of these "meridian cells," which have since been found to be located at acupressure points (Bauer, 1987).

Similar results were obtained by Becker and Reichmanis (1976). They used teflon electrodes to measure the

difference in electrical resistance and conductivity between acupuncture points and meridians and other areas of the skin. They found that electrical conductivity is greatest at these points and decreases by 5 mV in surrounding areas. This provides some evidence that acupuncture points can be measured and possess properties that are different from surrounding tissues.

Becker and Reichmanis (1976) also placed two electrodes a few centimeters apart along one of the meridians and set up a parallel pair one centimeter away from them. The electrical current passed far more readily along the meridian line than along its parallel. Thus, one might deduce that there are specific electrical properties at the points and along the meridians that are different from those of the surrounding tissues (Dalet, 1980).

Scientific Basis For Stimulation to Acupoints

A neurophysiologist named Melzack has investigated the properties of cutaneous stimulation to acupoints. In 1962, he described cutaneous sensory receptors as multidimensional. Instead of using Von Frey's classification of receptors into specified touch, warmth, cold, and pain sensing nerve endings, he found that each nerve ending varies in threshold to a variety of sensory stimuli. Thus,

he found that a single nerve ending may be sensitive in varying degrees to touch, warmth, cold and pain sensations. Since nerve endings are not modality specific, each generates patterns of impulses using spatial and temporal summation which can then be identified by the nervous system. As the messages travel to higher levels of the nervous system, they may be modified, inhibited, or magnified. Melzack identified pain as summation, or the excessive stimulation of fibers both in number and in frequency of impulses. At this level, pain can be affected through the inhibition of nerve impulse summation.

Melzack (1962) has dedicated considerable research to the study of pain and relief from pain. He began to explore the similarities between acupuncture points and trigger points. Trigger points are used in the application of TENS, or transcutaneous electrical nerve stimulation, described in Western medical literature. In 1975, he examined the effects of TENS at trigger points and at acupuncture points (Melzack, 1975). In another study, Fox and Melzack (1976) compared the relative effectiveness of transcutaneous stimulation and acupuncture on low back pain. In this study they identified that there was no statistical difference in the intensity or duration of pain relief after stimulating the same points using TENS or acupuncture. In other words, neither method was statistically more effective than the

other in the relief of pain.

In yet another study, Melzack, Stillwell, and Fox (1977) examined the correlation between trigger points and acupuncture points for pain. The results showed that for every trigger point reported in Western medical literature, there was a corresponding acupuncture point. There is a close correspondence of 71% between acupuncture points and trigger points on the basis of two criteria, spatial distribution throughout the body and associated pain patterns.

In 1981, Melzack went further to discuss the physiological basis of hyperstimulation analgesia. He identified three major properties of hyperstimulation analgesia produced by stimulation to acupuncture points as well as trigger points:

- 1) a moderate-to-intense sensory input is applied to the body to alleviate pain, 2) the sensory input is sometimes applied to a site distant from the site of pain, and 3) the sensory input, which is usually of brief duration (ranging from a few seconds to 20 or 30 minutes) may relieve chronic pain for days, weeks, sometimes permanently (p. 116).

Although discovered independently and labelled differently, trigger points and acupoints can be explained in terms of the same underlying neural mechanisms (Melzack, 1981).

The neural mechanisms to which Melzack refers are those underlying the gate control theory (Melzack & Wall, 1965). The gate control theory was first proposed by Melzack and Wall in 1965. Since that time, considerable research and revisions have been made in support of this theory, although many have attempted to refute it. The gate control theory proposes that "neural mechanisms in the dorsal horns of the spinal cord act like a gate which can increase or decrease the flow of nerve impulses from peripheral fibers to the central nervous system" (pp. 114-115).

More specifically, the analgesic hyperstimulation in the form of pressure at acupoints is transmitted to the brain via A-delta fibers which are thick and insulated. Pain information is carried via the thinner and non-insulated C-fibers. The A-delta fibers allow for a much faster rate of conductivity of information than do the C-fibers. Thus, information from these fibers reaches the spinal cord much more quickly. The A-delta fibers synapse with inhibitory interneurons in the substantia gelatinosa of the spinal cord. These interneurons "close the gate" to pain messages carried via the C-delta fibers, thereby inhibiting or blocking the pain information from traveling to higher centers of the brain (Melzack, 1981).

In addition to the spinal cord, there are two other centers that are activated to cause analgesia, the midbrain

and the hypothalamus-pituitary. Each of these centers sends inhibitory signals to block the pain information at the spinal cord level (Stux & Pomeranz, 1987). These three activation centers will be explored further in the discussion of endorphins.

In a study similar to that of Fox and Melzack (1976), Oliveri, Clelland, Jackson, and Knowles (1976) examined the effects of TENS at auricular acupuncture points. The subjects were randomly assigned to three different groups: 1) a treatment group receiving TENS applied to appropriate acupuncture points, 2) a placebo group receiving TENS applied to inappropriate (placebo) acupuncture points, and 3) a control group receiving no TENS stimulation. Pain threshold was measured at the wrist before and after ear stimulation. Results indicated that only the treatment group that received stimulation at appropriate acupuncture points exhibited an increased pain tolerance.

TENS has been incorporated into the treatment of spasticity in clients with spinal cord injury (Bajd, Eng, Gregoric, Vodovnik, & Benko, 1985). In their study, spasticity was measured by the amount of passive resistance given by the knee extensor muscles. Severity of spasticity was recorded before, immediately after, and two hours after TENS treatment. A relaxation index was developed by repeating measurements ten times for each recording time.

The results indicated that a reduction in spasticity and increase in relaxation response immediately after and two hours after was found in three out of six subjects.

By recapitulating the results of some of the preceding studies, we may make an interesting deduction. In their study, Bajd et al. (1985) established that TENS may be effective in the treatment of spasticity of neurologically impaired clients. It was demonstrated by Olivera et al. (1976) that the application of TENS to acupuncture points may reduce pain. Finally, Fox and Melzack (1976) established that TENS and acupuncture stimulation were statistically similar in their relief of pain. One may then deduct that the stimulation of acupuncture points may reduce spasticity in a manner similar to TENS, and reduce the pain which effects the severity of spasticity in neurologically impaired clients (Carter, 1987).

There is yet further explanation for the effectiveness of stimulation to acupoints than understanding the principles underlying the gate control theory, which discusses the inhibition of neuronal summation of pain impulses. Stimulation to acupoints also reduces pain by causing the periaqueductal gray in the brain to release endorphins (Pomeranz, 1978). Endorphins are opiate-like substances that can be released in the "midbrain, limbic system, pituitary gland, and other structures of the nervous

system. They have been found to block pain transmission and to alter emotions, moods, and intestinal motility" (McCormack, 1985, p. 307). Endorphins are considered to be the body's natural painkillers and are structurally related to morphine. There are three families of endorphins: enkephalin, beta endorphin, and dynorphin (Stux & Pomeranz, 1987). It has been found that endorphins do not provide direct pain relief, but rather disinhibit or "close the gate" to the transmission of pain information by blocking the release of Substance P (Pomeranz, 1978). Substance P is an excitatory neurotransmitter which mediates information coming from nociceptive pathways to the substantia gelatinosa (McCormack, 1988).

According to Pomeranz and Stux (1989), when an acupoint is stimulated, impulses are sent to the spinal cord and three centers (spinal cord, midbrain, and hypothalamus-pituitary) are activated to block nociceptive information and produce analgesia. The spinal site uses enkephalin and dynorphin to block incoming pain messages. Enkephalin is used by the midbrain to activate the raphe nuclei descending system, which inhibits spinal cord pain transmission utilizing the synergistic effects of monoamines, serotonin, and norepinephrine. In the hypothalamus-pituitary center, beta endorphin is released into the blood and cerebral spinal fluid by the pituitary to cause analgesia at a

distance (in the midbrain). The hypothalamus transmits long axons to the midbrain which activate the descending analgesia system via beta endorphin.

As stated above, serotonin is indirectly released as a result of stimulation to acupoints. Booker (1982) states that serotonin "acts as an inhibitor to neuronal transmission. . .and will augment analgesia" (p. 327). Serotonin is a neurotransmitter responsible for the peaceful, relaxed feelings one experiences as the parasympathetic end of the autonomic nervous system is approached. This physiological state is further described by Benson.

Benson (1975) constructed the model of the relaxation response. It is described as an integrated hypothalamic response accompanied by a decrease in sympathetic arousal (resulting in a decrease in the following: oxygen consumption, carbon dioxide production, respiration rate, heart rate, arterial blood lactate, pH, and base excessive levels) and especially a decrease in muscle tone. The relaxation response is activated in the anterior hypothalamus of the brain and is considered a protective mechanism against overstress belonging to trophotropic endophlatic system (Benson, 1975; Titlebaum, 1988).

Shaffer (1982) gives similar characteristics of relaxation: 1) heart rate slows and becomes even; 2) breathing becomes deeper and more even; 3) muscles loosen

and relax; 4) hands feel warm or heavy, or both; 5) mind feels at peace; 6) the body has energy for at least several hours of work; and 7) the entire body feels refreshed.

In summary, acupressure results in an overall relaxation response, which might be due to the release of serotonin. Benson (1975), Shaffer (1982), and Titlebaum (1988) all appear to agree that the response of relaxation involves the relaxing of muscles. The relaxation response, in addition to the neural and physiological mechanisms (gate control theory and release of endorphins), may contribute to the reduction of muscle tone when acupressure treatment is utilized.

Research on the Clinical Use of Acupressure

Research on the use of acupressure has been conducted by Project Pres (Physical Response Education Systems) of Santa Cruz Office of Education, in Santa Cruz, California. During 1980 and 1981, 23 children in special education classrooms received one session of acupressure treatment per week for six to eight weeks. Four areas were evaluated during this time period: sensory motor, cognitive/communication, emotional/social, and health. The results demonstrated that 87 percent (20 students) improved in at least three areas and 74 percent (17 students) improved in

all four areas. More specifically, one nine-year old cerebral palsy student crawled, sat, stood, walked and spoke for the first time (St. John, 1981, 1987).

Much of the literature (Bauer, 1987; Cohen, 1985; Gach & Rosner, 1986; Mengle, 1984; Weaver, 1985) on acupressure has discussed the theoretical principles behind acupressure and have given explanations on how to use the technique with clients. One article by Joachim (1984) even goes through three brief case studies describing how acupressure relieved tension headaches in each of her three clients. However, none of the articles found by this researcher was completed research studies examining the effectiveness of acupressure as a treatment modality.

Well conceived scientific research on the use of acupuncture and the stimulation of acupoints has largely supported its efficacy. However, it is apparent that little research has been conducted on the use of acupressure. The above studies reflect the deficiencies in acupressure research. It is necessary to control variables and have an effective design for the collection of data which may be statistically analyzed.

The acceptance of acupressure by Western health professionals appears to be in its embryonic stages. Thus far, acupressure appears to have received the most attention by the nursing profession as evidenced by the number of

articles that have been written on the subject. However, these articles generally discuss what acupressure is and how to use it. It is anticipated that future articles will discuss, not only the "how to's," but the results of research on the clinical use of acupressure. It is the hope of this researcher to facilitate more research in this area. This investigation will serve as a preliminary study from which further research on the clinical use of acupressure may be conducted.

Occupational Performance Frame Of Reference

This study used the Occupational Performance Frame of Reference (Pedretti & Zoltan, 1990). This frame of reference views an individual's occupational performance, meaning his or her ability to accomplish the tasks required by his or her role and developmental stage in life (e.g., preschooler, student, homemaker, employee, etc.). The occupational performance skills which are examined are the areas of self-care, work, and play/leisure. Five performance components build the foundation of an individual's occupational performance skills: 1) sensory-integrative functioning, 2) motor functioning, 3) social functioning, 4) psychological functioning, and 5) cognitive functioning (Pedretti & Zoltan, 1990). When using the

Occupational Performance Frame of Reference, the purpose of the occupational therapy program is to assist the client to achieve maximal occupational performance for functional independence. Functional independence is the core concept of occupational therapy theory and the goal of the occupational therapy process (Rogers, 1982). This can be accomplished by addressing the above mentioned performance components utilizing a balance and continuum of treatment methods with the ultimate goal in mind, maximal occupational performance of the client.

Procedures that are utilized to prepare the client for occupational performance, but are preliminary to the performance skills, may be regarded as enabling activities or enabling techniques. Sensorimotor approaches to treatment assume that specific, controlled sensory input can influence motor responses and that abnormal motor responses can be inhibited and more normal motor responses can be learned by the CNS (Pedretti & Zoltan, 1990). Under this definition, acupressure may be considered a sensorimotor approach. Pedretti and Zoltan (1990) wrote that sensorimotor approaches, when used to precede and enable purposeful activity and as part of a purposeful activity, can be viable methods in the Occupational Performance Frame of Reference. In this study, the use of acupressure will be considered as a possible enabling method which could reduce

children with cerebral palsy and thus be a precursor to and prepare the child for purposeful activity during therapy.

Cerebral Palsy

Cerebral palsy is a non-progressive disorder primarily characterized by aberrant motor control and posture resulting from brain insults or injuries occurring in the prenatal, perinatal or infant period of development. Cerebral palsy is generally described according to (1) the predominant muscle tone pattern present in the individual and (2) the distribution of the motor dysfunction throughout the body (Powell, 1985). Spasticity is a muscle tone disorder that affects movement in which an increase in tone creates an imbalance between muscle groups. Spasticity is clinically seen as hypertonicity, hyperreflexia, degrees of paralysis, clonus, and weakness. As a result, spasticity interferes with the purposeful behaviors of individuals who have neurological deficits.

Summary

Occupational therapists are concerned with the effort to find techniques that will aid in the reduction of hypertonicity so that their patients may more independently

perform functional activities and thereby meet therapeutic goals. In some of the literature, it has been reported that acupressure may lead to relief of muscle tension headaches due to a generalized relaxation response (Joachim, 1984; Smith, 1988; Stumbo, 1986). Since a generalized relaxation response results in a decrease in muscular tone, hypertonicity may also be reduced (Benson, 1975). Thus, the use of acupressure to reduce spasticity warrants further exploration as a procedure which may assist in increasing the purposeful and functional activity of individuals who have spasticity (Thurston, 1986). However, considerable research still needs to be conducted in this area in order to document the effectiveness of acupressure and support its use in occupational therapy.

CHAPTER 3

DESIGN AND METHODOLOGY

Purpose

The purpose of this study was to determine the effectiveness of stimulating specific Chinese acupressure points that reportedly alleviate spasticity (increased muscle tone) in children with cerebral palsy.

Null Hypothesis

The null hypothesis tested in this research was:
During and after the application of acupressure, muscle tone of the frontalis muscle of children who have the diagnosis of cerebral palsy will not be significantly reduced as compared to the subject's initial electromyogram reading on the Biofeedback MicroLab.

Research Procedures

Research Design

This study used an single subject ABA design with five

subjects. This is a type of evaluation research which involves the "systematic application of applied research procedures to assess the conceptualization, design, implementation, and effectiveness of therapeutic intervention programs" (Ottenbacher, 1984). The "A" of the ABA design represents the no-treatment or baseline condition, while the "B" represents the intervention of acupressure. An EMG biofeedback machine was used to measure the muscle tone of the frontalis muscle of the subjects who are diagnosed with cerebral palsy before (A), during (B), and after (A) the therapeutic intervention of acupressure.

Technique

Therapeutic intervention of acupressure involves pressing the middle finger or the thumb against the accurate acupoint. In this study, the acupoints used were the Du2 and the Du 6 (please refer to Appendix A). Initially, a light circular motion was used and then, as the tissues softened, a change was made to firm stationary pressure on the accurate acupoint. The pressure used was approximately ten to fifteen pounds, depending on the body size of the individual (McCormack, 1993). In general, effective treatment time ranges from one to five minutes per treatment (Bauer, 1987; Mengle, 1984). In this study, five minutes of

acupressure was used.

Subjects

The subjects were four males who have a diagnosis of cerebral palsy, spastic quadriplegia and one male who has a diagnosis of cerebral palsy, spastic athetoid mixed quadriplegia type. Their ages ranged from 3 years, 8 months to 13 years, 3 months. They were found by contacting California Children Services (CCS) of Santa Clara County, an agency that serves many children who have this diagnosis. Letters requesting participation in this study were given to the therapists and classroom teachers at a school in the San Francisco Bay area who work with children who have a cerebral palsy diagnosis (see Appendix B). These letters were sent home with the appropriate children at the end of the school day. Subjects were selected from those who responded to the letter. Each child's therapist was interviewed to identify children who met the following criteria: 1) subject does not demonstrate tactile defensiveness; 2) subject has good level of cooperativeness; and 3) subject is able to remain still for a ten-minute time period.

There were no significant risks to the subject. It was possible, however, that if a subject had sensitive skin,

he/she may have presented with a small red mark at the acupressure site from the light fingertip pressure. This small mark would disappear within ten minutes and would not cause any harm to the subject. The subject may have experienced a slight discomfort at the acupressure points due to the light fingertip pressure that was used. The pressure could be adjusted to lessen discomfort.

The subject may have benefitted from participating in this study in that he/she may have experienced a temporary reduction in muscle tone that may have assisted in the performance of functional activities in his/her therapy session, in the classroom, or at home. There was no compensation awarded to the subjects as an incentive for participating in the study. However, each child received a small thank you gift from this investigator.

Description of Study

The study took place on-site at the school that the subjects normally attended. They were brought to the research site from home by their parent(s) or caretaker to receive the acupressure treatment. After the data were collected, each subject was returned home. The research process took approximately 30 minutes per subject.

The subjects and their parents/caregivers were provided

with information on the study and their rights as human subjects. The parents or legal guardians were informed and asked to sign a consent form. Parents, guardians, or therapists were welcome to be present during the time of the study.

Since an extended bowel or bladder may have an influence on a subject's muscle tone, each subject's bowel and bladder were voided immediately prior to the administration of acupressure.

There were two investigators who conducted this study. Monica Sampson, OTR (investigator) is the primary investigator who is writing this thesis. This investigator took all of the measurements during the research. Guy L. McCormack, Ph.C., OTR (practitioner) is the individual who is well-practiced in acupressure. He was responsible for performing the acupressure on each subject by giving light fingertip pressure and pressing two points on the back for five minutes while the subjects were in a sidelying position. Stimulation to these acupoints is documented by Stux and Pomeranz (1987) to reduce spasticity. Please see Appendix A for picture designating the specific acupressure points which were be used to reduce muscle tone.

Each subject was brought into a neutrally lighted room with limited surrounding noise. The subject was placed on a comfortable table in a sidelying position and had

electromyogram (EMG) sensors placed on the frontalis muscle of his forehead. Muscle activity was monitored for ten minutes: two minutes before, five minutes during, and three minutes after the administration of acupressure. When the collection of data was complete, the EMG sensors were removed from the subject's forehead and the subject was taken home.

Collection Techniques

Electromyogram (EMG) sensors from the Biofeedback MicroLab software using the Apple IIe computer were used to monitor muscle activity before, during, and after the intervention of acupressure. The target muscle was the frontalis muscle, which is located on the forehead. This muscle was chosen because it is a good indicator of overall muscle tone and general body relaxation (Basmajian, 1989).

The investigator used the software to take readings of muscle tone at two second intervals for the entire ten minute experimental procedure, so that readings were taken for 1) two minutes prior to acupressure intervention, 2) five minutes during acupressure intervention and 3) three minutes after acupressure intervention.

The investigator made the subject comfortable and placed the subject in a sidelying position. The recording

units were placed on the subject's forehead over the frontalis muscle by the investigator following the directions given in the Biofeedback MicroLab instruction manual. Instrumentation parameters were set before the child arrived. Measurements were taken to establish a baseline of the subject's muscle tone for a two-minute time period which began as soon as the investigator pushed the key on the computer keyboard. This marked the beginning of Phase A1. The investigator marked the end of the two-minute baseline and beginning of the five-minute interval on the computer screen. At the same time that this event was marked on the computer, the investigator signalled to the practitioner to begin the administration of acupressure. After five minutes of the acupressure, the investigator signalled to practitioner to stop the administration of acupressure and simultaneously marked on the computer screen to denote the end of Phase B and the beginning of the Phase A2. The EMG biofeedback machine continued to measure muscle tone for three minutes. At the end of the three minutes, the investigator marked the end of the event on the computer screen. The recording units were taken off the subject's forehead by the investigator and the subject was taken home.

Statistical Analysis

The data were analyzed using graphic analysis and visual inspection in addition to two statistical analysis methods appropriate for the single subject case study design. Ottenbacher (1986) describes these methods as the two standard deviation band method and the C statistic. Data were considered statistically significant at a level of $\underline{p} < .05$.

CHAPTER 4

DATA AND RESULTS

Data

Data for this study were collected from clients of California Children Services of Santa Clara County. A total of five subjects participated in this single-subject case design study. All five of the subjects were males with the diagnosis of cerebral palsy, spastic quadriplegia, with the exception of one male subject with the diagnosis of cerebral palsy, spastic athetoid mixed quadriplegia. Subjects' ages ranged from 3 years, 8 months to 13 years, 3 months. The mean age of the subjects was 7 years, 6 months, while the median age was 7 years, 11 months. Please refer to Table 1 for the demographics on each subject. All five subjects were individually brought into the same treatment room and received the same acupuncture treatment from the same individual.

A brief description of each subject including age and diagnosis, as well as observations of the subject that were noted by this examiner during the time of the research, are

Table 1

Subject Demographics: Age/Type of Cerebral Palsy

Subject	Age	Type of Cerebral Palsy
ONE	4 yr., 7 mo	Spastic quadriplegia
TWO	13 yr., 3 mo	Spastic quadriplegia
THREE	7 yr., 11 mo	Spastic quadriplegia
FOUR	8 yr., 5 mo	Spastic athetoid, mixed quadriplegia
FIVE	3 yr., 8 mo	Spastic quadriplegia

reported in the following sections on each subject. Further information was not available due to confidentiality and consideration for human subjects policies. Since each subject served as his own comparison, the statistics for each subject have been calculated accordingly, using statistical procedures to analyze data from single system designs. These include the C-Statistic and the Two Standard Deviation Band Method, in conjunction with graphic and visual inspection of the data. These procedures have been thoroughly described by Ottenbacher (1986). An overall summary of the statistical results can be found in Tables 2, 3, and 4.

There are five figures (a, b, c, d, and e) for each of the subjects (1, 2, 3, 4, and 5) that graph the EMG readings of muscle tone (measured in millivolts) before (A1), during (B), and after (A2) the administration of acupressure. Thus, Subject ONE will have Figure 1a, 1b, 1c, 1d, and 1e; Subject TWO will have Figure 2a, 2b, and so on. Each of these graphs designates the baseline mean and the standard deviation bands for that subject which may be used for visual and graphic inspection.

It was found that a series of graphs needed to be used to aid in visual inspection and to clarify and problem solve the ambiguity of the graphs of the raw data. Since the raw data were measured every two seconds, there generally were

Table 2

Two Band Standard Deviation

	SUBJECT				
	ONE	TWO	THREE	FOUR	FIVE
<u>M</u>	4.431	4.410	1.805	9.802	8.241
<u>SD</u>	1.540	2.082	.225	8.890	3.866
<u>M + 2SD</u>	7.510	8.573	2.256	27.582	15.973
<u>M + 1SD</u>	5.997	6.492	2.031	18.692	12.107
<u>M</u>	4.431	4.410	1.805	9.802	8.241
<u>M - 1SD</u>	2.891	2.329	1.580	.912	4.375
<u>M - 2SD</u>	1.351	.247	1.354	-7.978	.508

M = MeanSD = Standard deviation

Table 3

Z Scores from C-Statistic Analysis

PHASE	SUBJECT				
	ONE	TWO	THREE	FOUR	FIVE
A	.584	.358	.587	.529	.510
AB	6.116*	3.202*	2.447*	6.674*	7.409*
ABA	6.401*	2.627*	2.913*	7.737*	8.499*

$$\underline{Z} \text{ Score} = \frac{\underline{C} \text{ Statistic}}{\text{Standard Error}}$$

- * If $\underline{Z}$ score > 1.64, there is a statistical significance
 If $\underline{Z}$ score < 1.64, there is no statistical significance
 $\underline{p} < .05$

A = Baseline (before acupressure)
 AB = Baseline/Acupressure (before and during acupressure)
 ABA = Baseline/Acupressure/No acupressure (before, during,
 and after acupressure)

Table 4

Mean EMG Scores of Each Phase--Before (A1), During (B), and After (A2) Acupressure Intervention

PHASE	SUBJECT				
	ONE	TWO	THREE	FOUR	FIVE
A1	4.43	4.41	1.81	9.80	8.24
B	4.58	5.29	3.27	12.67	8.80
A2	5.81	6.10	1.16	10.71	9.09

wide fluctuations in the graphs with many peaks and valleys. The first pair of graphs ("Figure a" and "Figure b") for each subject show EMG scores (muscle tone measured in mV) with readings taken every two seconds. "Figure a" utilizes the same y-axis (0 to 45 millivolts) as for all of the other subjects and "Figure b", for clarity of visual inspection, utilizes a y-axis more specific to the measurements taken for the specific subject.

The Z-scores from statistical analysis (Table 3) demonstrated that there was a significant trend in the data, but this statistical analysis relies on graphic visual inspection to determine the direction of the trend. However, from the graphs of the raw data ("Figure a" and "Figure b"), it was not possible to determine a trend in the data. Therefore, the data needed to be normalized, so as to average out the scores and decrease the amplitude of the peaks and valleys. Thus, in order to further aid visual inspection, "Figure c" and "Figure d" for each of the subjects have been included in the results. Using the same data points, an average reading was obtained every 20 seconds throughout the ten minutes (600 seconds) of recordings to make the graphs more readable. "Figure c" uses the same y-axis as the other subjects (as does "Figure a") and "Figure d" utilizes the same y-axis as "Figure b" for that particular subject. The baseline mean will be

designated in blue, the first standard deviation bands above and below the baseline mean are designated in red, and the second standard deviation bands above and below the baseline mean are designated in green.

Lastly, "Figure e" for each of the subjects shows the average EMG reading for each phase (A1, B, and A2) of the study. This will help to find overall trends of the data by taking an average score for each of the three phases. Table 4 shows the numerical values for this graphic representation.

Subject ONE

Subject ONE was a 4 year, 7 month old male with the diagnosis of cerebral palsy, spastic quadriplegia. Please refer to Figures 1a, 1b, 1c, 1d, and 1e for graphs depicting EMG measurements of muscle tone before, during, and after the administration of acupressure. Visual inspection of the graphs and examination of the raw data demonstrates that there were no readings during any of the phases (A1, B, or A2) that were at or below the second standard deviation band, but there was a trend of readings at or below the

Figure 1a

EMG Scores Taken Every 2 Seconds Before (A1), During (B),
and After (A2) Acupressure Intervention

Figure 1b

EMG Scores Taken Every 2 Seconds Before (A1), During (B),
and After (A2) Acupressure Intervention

Figure 1c

EMG Scores Averaged Every 20 Seconds Before (A1), During (B), and After (A2) Acupressure Intervention

Figure 1d

EMG Scores Averaged Every 20 Seconds Before (A1), During (B), and After (A2) Acupressure Intervention

Figure 1e

Mean EMG Scores of Each Phase--Before (A1), During (B), and After (A2) Acupressure Intervention

SUBJECT ONE

first standard deviation band of ($\bar{M} - 1SD = 2.891$ mV). Of the data points in each phase, 6% before (A1), 15% during (B), and 11% after (A2) fell below the first standard deviation band.

The C-Statistic for the baseline, (A1), ($Z = .584$) shows that there is no statistical significance and thus no trend in the baseline, and that further analysis may be made for the other phases. The C-Statistic for AB (before and during acupuncture) and ABA (before, during, and after acupuncture) are $Z = 6.116$ and 6.401 , respectively. These demonstrate that there is statistical significance or a trend, but do not designate a direction to the trend. Visual inspection of the graphs in Figures 1a, 1b, 1c, 1d, and 1e is needed to further understand these results. In Figure 1a and 1b, there are many peaks with highs and lows of muscle tone readings. Upon observation, this subject appeared to be irritable throughout the entire session; he was fearful of the new situation and the investigators who were strangers to him. He was crying and times, would briefly relax, and then escalate and become upset. This would have an effect on the frontalis muscle. Figures 1c and 1d show that there is a general trend downward and then upward during Phase B and then an upward trend in Phase A2. Figure 1e and Table 4 show that a slight overall increase in Phase B ($\bar{M} = 4.58$) from Phase A1 ($\bar{M} = 4.43$) and then a greater increase in

phase A2 ($\bar{M} = 5.81$). There does not appear to be a significant overall reduction in muscle tone for SUBJECT ONE, although it appears that there may have been brief moments when acupressure had some influence on a decrease in muscle tone.

Subject TWO

Subject TWO was a 13 year, 3 month old male with the diagnosis of cerebral palsy, spastic quadriplegia. Please refer to Figures 2a, 2b, 2c, 2d, and 2e for graphs depicting EMG measurements of muscle tone before, during, and after the administration of acupressure. Visual inspection of these graphs and examination of the raw data demonstrates that there were no readings during any of the phases (A1, B, or A2) that were at or below the second standard deviation band, but there were few readings at or below the first standard deviation band ($\bar{M} - 1SD = 2.329$ mV). Of the data points in each phase, 8% before (A1), 4% during (B), and 0% after (A2) fell below the first standard deviation band.

The C-Statistic for the baseline, (A1), ($Z = .358$) shows that there is no statistical significance and thus no trend in the baseline, and that further analysis may be made for

Figure 2a

EMG Scores Taken Every 2 Seconds Before (A1), During (B),
and After (A2) Acupressure Intervention

Figure 2b

EMG Scores Taken Every 2 Seconds Before (A1), During (B),
and After (A2) Acupressure Intervention

Figure 2c

EMG Scores Averaged Every 20 Seconds Before (A1), During (B), and After (A2) Acupressure Intervention

Figure 2d

EMG Scores Averaged Every 20 Seconds Before (A1), During (B), and After (A2) Acupressure Intervention

Figure 2e

Mean EMG Scores of Each Phase--Before (A1), During (B), and After (A2) Acupressure Intervention

SUBJECT TWO

the other phases. The C-Statistic for AB (before and during acupressure) and ABA (before, during, and after acupressure) are $\underline{Z} = 3.202$ and 3.627 , respectively. These demonstrate that there is statistical significance or a trend, but do not designate a direction to the trend. Visual inspection of the graphs in Figures 2a, 2b, 2c, 2d, and 2e is needed to further understand these results. In Figure 2a and 2b, there are many peaks with highs and lows of muscle tone readings. Upon observation, this subject appeared to be interested and curious about what was happening in his surroundings. Thus his eyes moved around to whatever caught his interest. With the eye movement, there was also some activation of the frontalis muscle. Figures 2c and 2d show a gradual upward trend with occasional dips which might reflect brief periods of relaxation. However, overall the trend was upward. Figure 2e and Table 4 also verify this gradual upward trend; Phase A1 ($\underline{M} = 4.41$), Phase B ($\underline{M} = 5.29$), and Phase A2 ($\underline{M} = 6.10$). There does not appear to be a significant overall reduction in muscle tone for Subject TWO, although it appears that there may have been brief moments when acupressure had some influence on a decrease in muscle tone.

Subject THREE

Subject THREE was a 7 year, 11 month old male with the diagnosis of cerebral palsy, spastic quadriplegia. Please refer to Figures 3a, 3b, 3c, 3d, and 3e for graphs depicting EMG measurements of muscle tone before, during, and after the administration of acupressure. Visual inspection of these graphs and examination of the raw data demonstrates that there were numerous readings before, but especially during and after the administration of acupressure that fell at or below the second standard deviation band ($M - 2SD = 1.354$ mV). Please note that this is not only the first standard deviation band, but the second standard deviation band below the baseline mean. Of the data points in each phase, 11.6% before (A1), 66.6% during (B), and 96.6% after (A2) fell below the second standard deviation band.

The C-Statistic for the baseline, (A1), ($Z = .587$) shows that there is no statistical significance and thus no trend in the baseline, and that further analysis may be made for the other phases. The C-Statistic for AB (before and during acupressure) and ABA (before, during, and after acupressure) are $Z = 2.447$ and 2.913 , respectively. These demonstrate that there is statistical significance or a trend, but do not designate a direction to the trend. Visual inspection

Figure 3a

EMG Scores Taken Every 2 Seconds Before (A1), During (B),
and After (A2) Acupressure Intervention

Figure 3b

EMG Scores Taken Every 2 Seconds Before (A1), During (B),
and After (A2) Acupressure Intervention

Figure 3c

EMG Scores Averaged Every 20 Seconds Before (A1), During (B), and After (A2) Acupressure Intervention

Figure 3d

EMG Scores Averaged Every 20 Seconds Before (A1), During (B), and After (A2) Acupressure Intervention

Figure 3e

Mean EMG Scores of Each Phase--Before (A1), During (B), and After (A2) Acupressure Intervention

SUBJECT THREE

of the graphs in Figures 3a, 3b, 3c, 3d, and 3e and the results of the Two Standard Deviation Band Method are needed to further understand these results. From Figure 3a and 3b, it is clear that there is a definite downward trend in the readings over time during and after the administration of acupressure. It can also be seen that there were some high measurements taken at the very onset of the administration of acupressure. This may be accounted for by the subject's reaction to the administration of touch on his body. However, as he was able to accommodate to the touch, it appears that he was able to receive the benefits of the acupressure as noted in the reduction of muscle tone. It should be noted that this subject was not as visually and cognitively aware of his surroundings as were some of the other subjects and may have been responding purely to the administration of acupressure. Figures 3c and 3d also support the downward trend that was observed in Figures 3a and 3b. However, Figure 3e and Table 4 do not demonstrate this same support. Figure 3e shows an upward trend from Phase A1 (before) to Phase B (during) and then a dramatic downward trend in Phase A2 (after) which is much lower than the readings in Phase A1 (before). Likewise, Table 4 is a numeric representation of Figure 3e; Phase A1 ($\bar{M} = 1.81$), Phase B ($\bar{M} = 3.27$), and Phase A2 ($\bar{M} = 1.16$). This inconsistency between Figures 3a, 3b, 3c, 3d compared with

Figure 3e and Table 4 can easily be explained by understanding that the initial higher readings during Phase B raised the mean scores which were portrayed in Figure 3e and Table 4. In conclusion, Subject THREE demonstrated a significant overall reduction in muscle tone during and after the administration of acupressure. In fact, the after effect of acupressure appeared to produce even lower EMG readings of muscle tone for up to three minutes after the administration of acupressure.

Subject FOUR

Subject FOUR was an 8 year, 5 month old male with the diagnosis of cerebral palsy, spastic athetoid, mixed quadriplegia. This diagnosis is different from the other four subjects and suggests that the subject's muscle tone is abnormally high, but that it may also quickly fluctuate from high to low muscle tone for a variety of reasons. Please refer to Figures 4a, 4b, 4c, 4d, and 4e for graphs depicting EMG measurements of muscle tone before, during, and after the administration of acupressure. Visual inspection of these graphs and examination of the raw data demonstrates that there were no readings during any of the phases (A1, B,

Figure 4a

EMG Scores Taken Every 2 Seconds Before (A1), During (B),
and After (A2) Acupressure Intervention

Figure 4b

EMG Scores Taken Every 2 Seconds Before (A1), During (B),
and After (A2) Acupressure Intervention

Figure 4c

EMG Scores Averaged Every 20 Seconds Before (A1), During (B), and After (A2) Acupressure Intervention

Figure 4d

EMG Scores Averaged Every 20 Seconds Before (A1), During (B), and After (A2) Acupressure Intervention

Figure 4e

Mean EMG Scores of Each Phase--Before (A1), During (B), and After (A2) Acupressure Intervention

SUBJECT FOUR

or A2) that were at or below the first standard deviation band and thus also did not fall at or below the second standard deviation band ($\underline{M} - 1SD = 2.329$ mV).

The C-Statistic for the baseline, (A1), ($\underline{Z} = .529$) shows that there is no statistical significance and thus no trend in the baseline, and that further analysis may be made for the other phases. The C-Statistic for AB (before and during acupressure) and ABA (before, during, and after acupressure) are $\underline{Z} = 6.674$ and 7.737 , respectively. These demonstrate that there is statistical significance or a trend, but do not designate a direction to the trend. Visual inspection of the graphs in Figures 4a, 4b, 4c, 4d, and 4e is needed to further understand these results. In Figure 4a and 4b, it is difficult to notice the direction of the trend because there are many spikes with highs and lows of muscle tone readings, which is common for an individual with this diagnosis. However, when viewing Figures 4c and 4d, the direction of the trend is a little more obvious. During the intervention of acupressure (Phase B), there is a trend upward and then slightly downward toward the end of Phase B and the beginning of Phase A2. Figure 4e and Table 4 also verify this gradual upward trend; Phase A1 ($\underline{M} = 9.80$), Phase B ($\underline{M} = 12.67$), and Phase A2 ($\underline{M} = 10.71$). There does not appear to be a significant overall reduction in muscle tone for Subject FOUR.

Subject FIVE

Subject FIVE was a 3 year, 8 month old male with the diagnosis of cerebral palsy, spastic quadriplegia. Please refer to Figures 5a, 5b, 5c, 5d, and 5e for graphs depicting EMG measurements of muscle tone before, during, and after the administration of acupressure. Visual inspection of these graphs and examination of the raw data demonstrates that there were no readings during any of the phases (A1, B, or A2) that were at or below the second standard deviation band but there were few readings at or below the first standard deviation band ($M - 1SD = 4.375$ mV). Of the data points in each phase, 6.6% before (A1), 12% during (B), and 1.1% after (A2) fell below the first standard deviation band.

The C-Statistic for the baseline, (A1), ($Z = .510$) shows that there is no statistical significance and thus no trend in the baseline, and that further analysis may be made for the other phases. The C-Statistic for AB (before and during acupressure) and ABA (before, during, and after acupressure) are $Z = 7.737$ and 8.499 , respectively. These demonstrate that there is statistical significance or a trend, but do

Figure 5a

EMG Scores Taken Every 2 Seconds Before (A1), During (B),
and After (A2) Acupressure Intervention

Figure 5b

EMG Scores Taken Every 2 Seconds Before (A1), During (B),
and After (A2) Acupressure Intervention

Figure 5c

EMG Scores Averaged Every 20 Seconds Before (A1), During (B), and After (A2) Acupressure Intervention

Figure 5d

EMG Scores Averaged Every 20 Seconds Before (A1), During (B), and After (A2) Acupressure Intervention

Figure 5e

Mean EMG Scores of Each Phase--Before (A1), During (B), and
After (A2) Acupressure Intervention

SUBJECT FIVE

not designate a direction to the trend. Visual inspection of the graphs in Figures 5a, 5b, 5c, 5d, and 5e is needed to further understand these results. In Figure 5a and 5b, there are many spikes with highs and lows of muscle tone readings. Upon observation, this subject was very active during the session. He wanted to observe what was happening in the room and moved his head, eyes, and arms to try and interact with the people and objects surrounding him. This may have had an effect on the readings that were taken from his frontalis muscle. Figures 5c and 5d show an initial downward trend and then upward trend during the administration of acupressure (Phase B) and then again an initial downward trend followed by an upward trend after the administration of acupressure (Phase A2). These short downward trends might reflect brief periods of relaxation. However, overall the trend was upward. Figure 5e and Table 4 also verify this gradual upward trend; Phase A1 ($\bar{M} = 8.24$), Phase B ($\bar{M} = 8.80$), and Phase A2 ($\bar{M} = 9.09$). There does not appear to be a significant overall reduction in muscle tone for Subject FIVE, although it appears that there may have been brief periods at the beginning of Phase B and the beginning of Phase A2 where the intervention of acupressure may have had a slight influence on a decrease in muscle tone.

Results

The following hypothesis was posed at the outset of this study: During and after the application of acupressure, muscle tone of the frontalis muscle of children who have the diagnosis of cerebral palsy will not be significantly reduced as compared to the subject's initial electromyogram reading on the Biofeedback MicroLab.

The results of this study neither support nor refute this hypothesis or the efficacy of acupressure as an enabling technique for the reduction of muscle tone. Upon analysis of the data and through visual inspection of the graphs, it was found that four subjects did not show a significant decrease in muscle tone, while one subject did. However, the four subjects who did not show an overall decrease in muscle tone generally experienced brief periods of time in which a decrease in muscle tone was evident during and/or after the acupressure intervention.

CHAPTER 5

DISCUSSION, IMPLICATIONS, RECOMMENDATIONS, AND SUMMARY

Discussion

This study was performed to determine whether the traditional modality of acupressure would significantly produce a reduction of muscle tone in children with cerebral palsy. The muscle tone of the frontalis muscle of five subjects was measured for ten minutes over two second intervals using an EMG biofeedback instrument (Biofeedback MicroLab software on an Apple IIe computer). During the first two minutes (Phase A1), each subject's baseline muscle tone was measured without acupressure; during the next five minutes (Phase B) recordings of muscle tone were made while acupressure was administered to the subject; and during the last three minutes (Phase A2) muscle tone continued to be measured without and after the administration of acupressure. This is considered an ABA design, A signifying no treatment and B signifying administration of treatment. A description of the statistical analysis was presented in Chapter 4. This chapter includes a discussion, implications

for the occupational therapy profession, recommendations for further research.

The results of this study neither support nor refute the hypothesis (which was posed at the onset of this study) or the efficacy of acupressure as an enabling technique for the reduction of muscle tone. Upon analysis of the data and through visual inspection of the graphs, it was found that four subjects did not show a significant decrease in muscle tone, whereas one subject did exhibit a significant decrease in muscle tone. However, the four subjects who did not show an overall decrease in muscle tone generally demonstrated brief periods of time in which they experienced a decrease in muscle tone during and/or after the acupressure intervention.

This researcher was unable to control for the subject's level of anxiety, especially regarding an unfamiliar situation (unfamiliar room, intimidating/interesting computer, EMG sensors placed on forehead, quiet environment with several adults in room, etc.) and unfamiliar adults. With so many outside variables that came into play during this research it is very difficult to make an accurate determination as to the effectiveness of acupressure.

However, one of the subjects, Subject THREE, did not appear to be affected by the environmental distractions and seemed to respond solely to the acupressure treatment

itself. It was observed by this investigator that he did not appear to be as cognitively and visually responsive as the other subjects. Thus, his reduction of muscle tone may have been a true reflection of the effectiveness of acupressure. Subject THREE's first response to the inherent touch provided by the acupressure appeared to be unsettling to him, as noted by the initial, brief upshot in muscle tone. However, as he accommodated to the touch, it appears that the acupressure was able to demonstrate its effectiveness with a reduction in muscle tone.

It is not clear if all subjects would have responded in a similar manner had the environmental influences and unfamiliarity with the investigators been ruled out, or whether some subjects would respond more positively with a decrease in muscle tone. Continued research may address this issue.

It is possible that the acupoints which were used for this study (Du 2 and Du 6, see Appendix A for an illustration) may only be a set of acupoints of many other acupoints which may be utilized in the reduction of muscle tone. Although Stux and Pomeranz (1987) provide this set of acupoints as being effective in reducing spasticity, these acupoints may not be the most effective acupoints used in the reduction of muscle tone; other acupoints may have more

validity. Further research needs to be conducted in this area.

Implications

This study was designed to determine the effectiveness of acupressure as a modality for reducing muscle tone in children with cerebral palsy (clients who generally have abnormally high muscle tone), and thus be a precursor to and prepare the child for purposeful activity during therapy. Occupational therapists working in the specialty of pediatrics and/or physical disabilities frequently encounter clients with abnormally high muscle tone. Within the Occupational Performance Frame of Reference, muscle tone is one aspect of the motor functioning performance component. Abnormal muscle tone adversely affects motor function, which in turn negatively impacts the performance skills of play, self-care, work, and leisure. Deficits in performance skills cause overall occupational performance to be compromised.

Normalizing the client's muscle tone is thus often a prerequisite for performing functional activities and thereby meeting therapeutic goals. Occupational therapists may need to consider working toward normalizing the client's muscle tone before working on purposeful, functional, and

remedial activities within the realm of the performance skills, play, self-care, work, and leisure. Such normalization techniques may be regarded within the Occupational Performance Frame of Reference as enabling activities. Pedretti and Zoltan (1990) wrote that sensorimotor approaches when used to precede and enable purposeful activity can be viable methods in the Occupational Performance Frame of Reference. Enabling techniques are included in but do not constitute occupational therapy. Therefore, if acupressure is found to reduce muscle tone, it would be used as a preparation but not as a substitute for occupational therapy.

Recommendations For Further Research

Research that is exploratory elicits more questions than answers. The question regarding the contribution of acupressure as a treatment modality to assist in the reduction of muscle tone remains to be studied further. Suggestions for further research are addressed as follows. It is felt this research could be replicated with individuals who are not as distractible, would be less likely to demonstrate anxiety over an unfamiliar situation or unfamiliar adult, and would be able to cognitively follow and understand directions. Also it is suggested that a

longitudinal study be done to examine the subjects over a number of sessions. This might allow the subjects to become more familiar with the procedure and allow the subjects to accommodate to the type of touch inherent to acupressure.

If this study could be replicated with practitioners who have familiarity with the subjects, it may decrease the possible fear factor that a subject may experience when put in a new situation or with an unfamiliar adult. A trusting relationship may need to /be established before some of these young subjects can feel comfortable with the inherent touch that is provided through the administration of acupressure. Thus it is recommended that research be conducted with subjects for at least a one month period so that they can become familiar with the procedure and with the investigator. Ideally, the practitioner administering the acupressure and/or the investigator taking the measurements should be a person with whom the subject is familiar and comfortable in order to eliminate possible fearfulness on the part of the subject.

This study is ultimately looking at the Phase A2, after the treatment of acupressure, because functional outcomes of the client are the most important to consider. Future studies could further explore whether the use of acupressure will result in a reduction of muscle tone throughout the remainder of the therapy session and thereafter so that

therapeutic gains may be achieved through functional activity and to show that acupressure demonstrates true efficacy in muscle tone reduction.

Thus, this study could be replicated with more of a focus on the A2 Phase of the research, thus extending the duration of time that muscle tone is measured after the administration of acupressure. Another possibility might be to design an A1/B1/A2/B2 study where A1 is the baseline measurement, B1 is the treatment phase with acupressure, A2 is time period after acupressure, and B2 is a specific functional activity in which the subject engages.

Summary and Conclusion

The results of this study do not support nor refute the efficacy of acupressure as an enabling method. In short, the results are inconclusive. Based on the results of this limited sample, we cannot conclude that acupressure is in and of itself effective in reducing muscle tone. The literature review has shown some studies on the use of acupressure, but not on the result of muscle tone of children with cerebral palsy. In this study, one of the subjects had a significant decrease in muscle tone in response to the administration of acupressure, but the other four did not show a significant decrease in muscle tone.

The possible explanations have been discussed. The occupational therapy profession should be cautious about premature acceptance of acupressure as a valid treatment technique. It may be effective for some clients and not for others. The significant decrease in muscle tone of the Subject THREE certainly warrants further investigation into the use of acupressure as a method for muscle tone reduction. Therefore, it is believed by this investigator that further research in this area needs to be conducted before any significant conclusion can be drawn regarding the use of acupressure as an enabling activity and its efficacy for the profession.

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APPENDIX A
ACUPOINTS USED TO REDUCE SPASTICITY

APPENDIX A

Acupoints Used To Reduce Spasticity
Adapted from "Acupuncture Textbook
and Atlas" by G. Stux and B. Pomeranz,
1987, New York: Springer Verlag, p. 187.
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APPENDIX B
LETTER SEEKING RESEARCH SUBJECTS

A campus of The California State University

College of Applied Sciences and Arts • Department of Occupational Therapy
One Washington Square • San José, California 95192-0059
Main Office: 408/924-3070 • Fieldwork Office: 408/924-3078 • FAX: 408/924-3088

March 8, 1994

Dear Parents and/or Caregivers:

I would like to take this opportunity to introduce myself. My name is Monica Sampson and I am an occupational therapist who works in pediatrics. I am also working on my Master's Degree at San Jose State University and am conducting a research study on the use of acupressure to reduce spasticity in children with cerebral palsy. California Children Services has graciously allowed me to conduct the research at its facility and is in full support of this study. My contact person is Louise Sumpter, OTR.

Clinically acupressure has been effective in the reduction of muscle tone but there has been little research documenting its effectiveness. Thus there is a need to conduct further research in this area. The title of my study is "A Study Of The Effectiveness In Reducing Spasticity of Children With Cerebral Palsy".

I would like to invite you and your child to participate in this research study, which would only take a maximum of 30 minutes, including set-up, baseline recording, therapeutic treatment with acupressure, and an after-treatment recording. If you choose to have your child participate in this study, your child will receive acupressure treatment for five minutes during which time the muscle tone of his/her forehead will be monitored using the recording units of a biofeedback machine. In addition, muscle tone will be monitored two minutes before and three minutes after the five minute acupressure treatment, making the total monitoring time ten minutes long.

This procedure is not invasive. Your child would be positioned to lie comfortably in sidelying, propped with pillows, and would have light fingertip pressure applied to two points on his/her back by an occupational therapist and professor who is well-practiced in acupressure. Guy McCormack, M.S., OTR is a renowned speaker who has presented at many conferences, given workshops on the use of acupressure, and has published several books in this field.

Your child may benefit from the acupressure treatment by having a relaxation response or a reduction in muscle tone (a decrease in spasticity), which could then result in an increased participation in functional activities. It is our hope that spasticity may be reduced as a result of treatment using acupressure. However, we cannot guarantee or promise that your child will receive any short-term or long-term therapeutic gains from this study.

If you are interested in participating in this study and/or you have any questions or concerns, please feel free to contact me or leave a message on my answering machine at (415) 368-7785. If I'm not home I will return your call as soon as possible.

Thank you for taking the time to read this letter. I hope that we will have the opportunity to meet and that you would consider having your child participate in this study.

Sincerely,

Monica Sampson, OTR
Monica Sampson, OTR

APPENDIX C
SAMPLE CONSENT FORM

College of Applied Sciences and Arts • Department of Occupational Therapy
One Washington Square • San José, California 95192-0059
Main Office: 408/924-3070 • Fieldwork Office: 408/924-3078 • FAX: 408/924-3088

AGREEMENT TO PARTICIPATE IN RESEARCH AT SAN JOSE STATE UNIVERSITY

RESPONSIBLE INVESTIGATOR: Monica Sampson, OTR

TITLE OF PROTOCOL: Study of the Effectiveness of Acupressure in Reducing Spasticity of Children with Cerebral Palsy

1. My child is invited to participate in a research study that is investigating the treatment of spasticity with acupressure. The results of this study should further our understanding of acupressure and its effectiveness in reducing spasticity in children with cerebral palsy.
2. My child will be treated with acupressure, which consists of firm pressure applied to two acupressure points on the back (please see attached sheet for reference) for three minutes. My child's muscle tone will be monitored for a total of nine minutes—three minutes prior to the treatment using acupressure, three minutes during, and three minutes after. My child's muscle tone will be monitored by an EMG biofeedback machine from which recording units will be applied to my child's forehead over the frontalis muscle.
3. The possible risk of this study is that my child may experience a slight discomfort at the acupressure points described above due to the nature of the fingertip pressure that is used. This pressure can be adjusted to lessen discomfort.
4. The possible benefit of this study to my child is a decrease in the spasticity. It is our hope that spasticity may be reduced as a result of treatment using acupressure. However, we cannot guarantee or promise that your child will receive any short-term or long-term therapeutic gains from this study. We do not suggest that you use this form of treatment in lieu of traditional occupational and physical therapy which may also be effective.
5. The results from this study may be published, but any information from this study that can be identified with my child will remain confidential and will be disclosed only with my permission.
6. No compensation will be given for my child's participation in this study.
7. Any questions about my child's participation in this study will be answered by Monica Sampson, OTR at (415) 752-4888 (work) or (415) 368-7785 (home). Complaints about the procedures may be presented to Guy McCormack, MS, OTR (Graduate Study Advisor) at (408) 924-3084 or Lela Llorens, Ph.D., OTR, FAOTA (Occupational Therapy Department Chair) at (408) 924-2458. For questions or complaints about research subject's rights, or in the event of research-related injury, contact Serena Stanford, Ph.D. (Associate Academic Vice President for Graduate Studies & Research) at (408) 924-2480.

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175 Fifth Avenue
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January 24, 1995

Monica Sampson, OTR
1430 Gordon Street Unit "O"
Redwood City, CA 94061

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