Bridges Practice-Based Research Syntheses
Research and Training Center on Early Childhood Development

Volume 3, Number 3 December 2005

Influences of Craniosacral Therapy on the Health and Development of Infants and Young Children

Tracy L. Masiello, Ph.D., and Jennifer Pace, B.A.

The influence of craniosacral therapy was examined in studies including 69 children with and without disabilities or delays. Craniosacral therapy is a light touch intervention used by trained practitioners to address restrictions in the membranes and cerebrospinal fluid surrounding the brain and spinal cord. The reports included mostly case studies to determine the benefits of the practice on the health and development of infants and young children. Despite the fact that positive results were reported in all studies, methodological and procedural problems raise questions about the efficacy of the practice with infants and young children. The need for better designed and implemented studies is indicated.

Purpose

The purpose of this practice-based research synthesis is to ascertain claims about the influences of craniosacral therapy on the health and development of infants and young children. The practice is characterized by light touch used to manipulate the cranial system, which includes the soft tissue and bones of the head (the cranium area), the spine (the sacral area), and the pelvis. Craniosacral therapists specifically target membranes around the bones of the craniosacral area and the cerebrospinal fluid in order to alleviate restrictions believed to be negatively impacting the nervous system. Proponents of craniosacral therapy claim that the practice will prevent or improve conditions such as hyperactivity, Down's syndrome, autism, dyslexia, cerebral palsy, disrupted sleep patterns, breastfeeding difficulties, colic, ear infection, aphasias, seizures, and other health-related problems (Blum, 1999; Green, Martin, Bassett, & Kazanjian, 1999; Hewitt, 2004; Holtrop, 2000; Joyce & Clark, 1996; Katz, 1998; Van Loon, 1998). Despite claims supporting the use of the practice, questions have been raised regarding the extent to which craniosacral therapy actually "works" to improve child health and development (Rosenbaum & Law, 1996). In response to such questions, as well as to an increasing interest in finding effective alternative health interventions for children, this synthesis examines existing research on the use of craniosacral therapy with infants and young children.

The conduct of the synthesis was guided by a framework that focused on the degree to which variations in craniosacral therapy were associated with variations in health and developmental outcomes for infants and young children (Dunst, Trivette, & Cutspec, 2002). This approach to synthesizing research evidence differs from more traditional approaches to integrating research findings by its explicit focus on disentangling and unpacking the characteristics, features, and elements of environmental variables (Babbie, 1995; Bronfenbrenner, 1992) that are associated with behavioral or developmental differences.

Background

Cranial manipulation has its roots in the work of Dr. William Sutherland who in the early 1900s recognized that bones in the skull can move along the suture lines. He performed experiments on himself using helmet-like devices to apply different types of controlled and sustained pressures to different parts of his head. An observer recorded any noted personality changes, head pain, or coordination problems that he exhibited in response to the different pressure applications. Based on these experiments, Sutherland developed cranial osteopathy, a method

Bridges *is a publication of the Research and Training Center on Early Childhood Development, funded by the U. S. Department of Education, Office of Special Education Programs, Research to Practice Division (H324K010005). The opinions expressed in this paper are those of the Research and Training Center on Early Childhood Development, an organizational unit of the Center for Evidence-Based Practices at the Orelena Hawks Puckett Institute, and do not necessarily represent the views of the U. S. Department of Education.* *Copyright © 2005. The Puckett Institute. All rights reserved.*

for intervening in health problems through manipulation of the bones of the skull. Cranial bone manipulation has since been used by osteopaths to address cranial "deformities" or injuries (Arbuckle, 1948).

In the 1970s, osteopath John Upledger refined Sutherland's techniques into the current practice of craniosacral therapy (CST). CST is described as a gentle form of touch to manipulate the bones of the skull in a manner that affects the membranes and fluid surrounding the brain and spinal cord. The underlying theory of the practice is that there is a cranial "rhythm" to the flow of the cerebrospinal fluid within the craniosacral system and that any restrictions or changes to this rhythm can negatively affect a person's health. Improvement of the cranial rhythm and flow of the craniosacral system is expected to positively influence health and development.

Description of the Practice

While there is not a standard accepted definition of craniosacral therapy provided in the literature, proponents of the intervention describe the practice in rather similar, albeit general, ways. Therefore, for the purpose of this research synthesis, CST refers to a light touch intervention that is done by the hands of a trained practitioner in order to address restrictions in the membranes and cerebrospinal fluid surrounding the brain and spinal cord. The amount of pressure applied by the practitioner's touch is between 5 and 10 grams (about the weight of a nickel). Practitioners are typically health-care professionals such as chiropractors, physical therapists, massage therapists, and physicians.

Search Strategy

Search Terms

Identification of relevant studies was accomplished using the following search terms: craniosacral therapy, cranial adjustment, cranial manipulation, cranial integration, cranial osteopathy, skull, sacrum, cerebrospinal fluid, cerebrospinal pulse, intracranial pressure, central nervous system fascia, cranial bone, and cranial suture. The terms physical therapy, massage, chiropractic, osteopathic, manipulation, and adjustment were searched in conjunction with the preceding search terms. The terms child(ren), infant(s), and toddler(s) were used to limit the search results.

Sources

A computer-assisted bibliographic database search was conducted using Psychological Abstracts online (PsycINFO), Educational Resource Information Center (ERIC), Social Science Citation Index (SSCI), MEDLINE, Cochrane Database of Systematic Reviews (Cochrane DSR), Cochrane Database of Abstracts of Reviews of Effects (Cochrane DARE), Cochrane Central Register of Controlled Trials (CENTRAL), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Health Source: Nursing/Academic Edition, Dissertation Abstracts International, OCLC PapersFirst, OCLC ProceedingsFirst, National Technical Information Service (NTIS), REHABDATA, CIRRIE, InfoTrac Expanded Academic ASAP, Social Sciences Index, Education Index, WorldCat, and Academic Search Elite. A Web search using Google was also conducted. Hand searches of key journal articles and reference sections of craniosacral investigations were reviewed for other relevant empirical work.

Selection Criteria

The primary inclusion criterion was that studies investigated the influences of craniosacral therapy on the health or development of infants or young children. Therefore, the search was limited to studies investigating outcomes for children 6 years of age or younger.

Exclusion criteria. It was necessary to exclude certain studies during the initial phase of the search process. Studies were excluded if it seemed that the participants received cranial manipulations that were distinct from craniosacral therapy, such as cranial osteopathy or chiropractic adjustments (Colin, 1998; Marohn, 2002). In addition, studies were excluded if the investigator did not report outcomes of the therapy. If reports contained multiple case studies, only the case studies of children age 6 and younger are included in the synthesis.

Search Results

Twenty studies in 17 reports met the inclusion criteria. Table 1 includes selected characteristics of the study participants. Table 2 includes investigator descriptions of the craniosacral intervention, length of the intervention, research design, and outcome measures.

Participants

The 20 studies include 69 participants. Most study participants were 2 years of age or younger and four studies have participants older than 2 years of age. Participant diagnoses varied considerably across children. Twelve participants had medical diagnoses or health problems (e.g., gastroesophageal reflux, ear infection, projectile vomiting) while 52 participants had an identified disability (e.g., Down's syndrome, autism, cerebral palsy). Five participants had other health-related difficulties (e.g., ineffective suckling, "wobbly" muscle tone).

Practice Characteristics

Nine of the investigators (45%) provided detailed information regarding specific characteristics of the cranial manipulation used with participants. Specifically, they indicated that particular bones were manipulated and reported the direction of the manipulations. All nine investigators targeted the occiput and sphenoid bone for intervention. Other targeted areas of the craniosacral

system varied across participants.

Eight investigators (40%) provide nonspecific information regarding the actual practice of the therapy, either simply stating that cranial corrective procedures were used with participants or that they "worked on" certain regions of the craniosacral system. Three investigators (15%) provide no information regarding the craniosacral manipulations of participants.

Only four investigators (20%) reported the length of each craniosacral treatment (range: 20-50 minutes). Fourteen investigators (70%) reported the total number of craniosacral treatments participants received (Range: 2- ~88 treatments).

Treatment fidelity. No treatment fidelity measures were reported in any study, nor was any variation in the degree to which craniosacral therapy was experienced by study participants measured objectively. The fact that no treatment fidelity measures were reported makes it difficult to ascertain whether children in any one study experience the same level or intensity of intervention or to ascertain the extent to which the investigators implemented the therapy treatments according to preset specifications for the treatment (Gall, Borg, & Gall, 1996).

Research Designs

Nineteen of the investigators (95%) describe results of case studies. One investigator reports results from a randomized clinical trial in which children received craniosacral therapy or acupuncture (Duncan, Barton, Edmonds, & Blashill, 2004).

Outcomes

All investigators measured participant health improvements or developmental gains as a result of CST. In 15 studies (75%), treatment outcomes were determined by investigator observations of improvement, with 10 of those 15 studies using parent observations as additional measures of treatment effect. One investigator reported a lactation consultant's observation as a third measure, while another used an oculist's report. Two investigators stated that they conducted physical exams, while one investigator reported using unspecified tests. Four studies used parent observation of improvement as the only outcome measure.

Synthesis Findings

Table 3 shows the findings from the studies as described by the investigators. Investigators reported improvements in child health, including decreases in gastroesophageal reflux, vomiting, ear infection, and seizures. Increases in vision, muscle tone, and hearing were also reported by some investigators. Positive developmental outcomes were reported by several investigators, including improvements in language development, motor functioning, and socio-emotional behavior.

Despite these reported benefits, a number of procedural and methodological problems, lack of detailed information regarding what is included in craniosacral treatments (i.e., the specific characteristics of the craniosacral treatments), lack of appropriate controls, the use of pre-experimental research designs, lack of statistical analyses, and other factors (e.g., rival explanations) call into question the claim that craniosacral therapy is the source of the reported benefits. The failure to employ research designs and methodological procedures that permitted simultaneous establishment of the benefits of craniosacral therapy and control over extraneous explanatory factors renders results from the studies uninterpretable.

The research designs used in a majority of the studies failed to control for extraneous factors (see Rival Explanations) that could explain any positive findings reported by the investigators (Cook & Campbell, 1979). All but one of the studies failed to utilize random assignment and control groups or other types of research designs, and all studies failed to employ design features necessary to rule out rival or alternative explanations for observed or reported findings (Yin, 2000). For example, although the investigators make claims regarding the benefits of craniosacral therapy, little or no data was collected to support these claims, making it difficult to determine the validity of their findings. Without adequate and appropriate statistical analyses it is impossible to determine if observed effects are significant, nor can it be determined whether or not the craniosacral characteristics lead to same or similar outcomes across studies. Only one investigator conducted a randomized clinical study; however, only outcomes reported by parents are provided and no statistical analyses are reported. In addition, the investigators provide inadequate information and details regarding the interventions and outcome measures, making it nearly impossible to replicate their results in future research.

As a whole, the studies fare poorly in terms of the kind of scientific rigor needed to conclude that observed effects are due entirely or even partly to craniosacral therapy. In the absence of adequate controls, the claim that craniosacral therapy is the primary source of these benefits is questionable.

Rival Explanations

Several threats to internal validity constitute possible explanations for observed effects (Campbell & Stanley, 1963; Cook & Campbell, 1979). *Investigator bias* is a potential problem that plagues most studies (79%), as the source for determining outcomes is based on the investigator's observations. Every investigator was aware of the anticipated outcomes for the treatment and served as the practitioner administering the therapy. Such research methods allow for investigator expectancies to influence

how child outcomes are interpreted.

Respondent bias and *selection* were common threats in most studies. All participants were selected for participation in the studies when their parents brought them to the practitioner for the specific purpose of receiving craniosacral treatment. Such convenience sampling increases the likelihood that respondent bias influenced parents' observations of the treatment's effects, since the parents are likely to have an expectation of improvement. It has been demonstrated that when individuals expect to witness improvements, they often will report the presence of such improvement (Pratkanis, Eskanazi, & Greenwald, 1994).

Instrumentation is a potential problem in all of the studies because no reliable instruments or procedures were used by any investigator to assess outcomes. Of the six studies that did use a measure of determining outcomes other than investigator and/or parent observations, no indication is provided regarding whether or not the instruments were reliable or appropriate. For example, one investigator reported using tests in conjunction with his observations to determine outcomes; yet the tests were not identified nor described, rendering it impossible to ascertain their reliability or validity.

Maturation is a threat in four studies. In these studies the treatment was implemented over extensive time periods, ranging from 10 to 40 weeks. Biological or psychological changes in the participants are likely to occur during that time period. For example, the fact that one participant began to sit up at 7 months of age and began to walk at 11 months is consistent with typical patterns of infant motor development (Gall et al., 1996) and thus not necessarily attributable to the CST treatments that the child received.

Multiple treatment interference is a threat in 11 studies (55%), as the participants in those studies received other treatments during the same time period in which they were receiving craniosacral therapy. Compensatory *equalization of treatments* is a threat in the one study using a group design because the non-CST group was administered a treatment (acupuncture). This is a potential threat because treatments are essentially compared to each other rather than testing one treatment with a no-treatment group, making it difficult to discern if observed effects are due to CST.

Conclusions

The findings from this practice-based research synthesis indicate that while the study investigators reported child benefits, there is a lack of sufficient evidence due to methodological flaws across the investigations to support claims about the effectiveness of craniosacral therapy with infants and young children. The lack of treatment fidelity measures, poor study designs (e.g., no random assignment to groups, no control groups), lack of statistical analyses, and possible threats to internal validity, lead to the conclusion that the empirical evidence to support the use of craniosacral therapy with children is meager at best. The lack of detailed information reported by investigators regarding what is included in the craniosacral treatments also calls into question the use of craniosacral therapy as a recommended practice. Consequently, the use of craniosacral therapy is not warranted as an evidence-based practice inasmuch as the research that is available is inconclusive regarding its effectiveness to produce hypothesized benefits.

A *Bottomlines* (Vol. 3, No. 3) companion report describes the major findings from this research synthesis in non-technical, user-friendly language. The *Bottomlines* summarizes what we know about the use of craniosacral therapy with infants and young children and is written specifically for parents and practitioners. Both the *Bridges* and *Bottomlines* reports are available to readers in electronic versions at our Web site (www.researchtopractice.info).

Implications for Research

Research methods are available to investigators that could conclusively evaluate the effectiveness of craniosacral therapy. Well-designed studies that include, for example, random assignment to experimental and control groups or single-participant research designs and the use of outcome measures that are valid and reliable would provide the kinds of evidence needed to support or refute claims about the effectiveness of CST. In addition, carefully implemented interventions would allow craniosacral therapy to be evaluated more objectively.

In the current synthesis, evaluating influences of craniosacral treatments proved to be a difficult challenge because the investigators did not often describe specific characteristics of the craniosacral treatments. More specifically, investigations of carefully designed and implemented craniosacral interventions would include, among other things, the following information in empirical reports: (1) detailed information regarding what is included in craniosacral intervention sessions or treatments (i.e, the specific characteristics of the craniosacral intervention); (2) the length of each craniosacral treatment in terms of minutes, days, and weeks; (3) the qualifications of staff implementing craniosacral treatments; (4) data collection using reliable and valid instruments and measures; (5) information regarding the implementation of any pretests/posttests; and (6) treatment fidelity measures. The inclusion of the above information would allow for more objective analysis and easier replication of investigations. In well-designed studies, the characteristics and consequences of the use of craniosacral therapy with young children could be better ascertained.

References

Adler, E. (2001). *CranioSacral Therapy: Infant recovers from seizure through help of CST*. Retrieved October 9, 2003, from http://www.upledger.com/therapies/cst_lisa.htm

Arbuckle, B. (1948). The cranial aspect of emergencies of the newborn. *Journal of the American Osteopathic Association, 47*(Pediatrics Suppl. 1,1), 507-511.

Babbie, E. (1995). *The practice of social research* (7th ed.). Belmont, CA: Wadsworth.

Barnes, J. F., Lawton-Shirley, N., Wanzek, D., & Weis, D. (1990). Pediatrics and myofascial release. In J. F. Barnes (Ed.). *Myofascial release: The search for excellence*. Paoli, PA: Rehab Services & Myofascial Release Seminar.

Blum, C. L. (1999). Cranial therapeutic treatment of Down's syndrome. *Chiropractic Technique, 11*(2), 66-76.

Bronfenbrenner, U. (1992). Ecological systems theory. In R. Vasta (Ed.). *Six theories of child development: Revised formulations and current issues* (pp. 187-248). Philadelphia: Jessica Kingsley.

Campbell, D. T., & Stanley, J. C. (1963). *Experimental and quasi-experimental designs for research*. Boston: Houghton-Mifflin.

Colin, N. (1998). Congenital muscular torticollis: A review, case study, and proposed protocol for chiropractic management. *Topics in Clinical Chiropractic, 5*(3), 27-33; 65-68.

Cook, T. D., & Campbell, D. T. (1979). *Quasi-experimentation: Design and analysis issues for field settings*. Boston: Houghton Mifflin Company.

Duncan, B., Barton, L., Edmonds, D., & Blashill, B. M. (2004). Parental perceptions of the therapeutic effect from osteopathic manipulation or acupuncture in children with spastic cerebral palsy. *Clinical Pediatrics, 43*, 349-353.

Dunst, C. J., Trivette, C. M., & Cutspec, P. A. (2002). Toward an operational definition of evidence-based practices. *Centerscope, 1*(1), 1-10. Available at: http://www.evidencebasedpractices.org/centerscope/centerscopevol1no1.pdf

Gall, M. D., Borg, W. R., & Gall, J. P. (1996). *Educational research: An introduction* (6th ed.). London: Longman.

Green, C., Martin, C. W., Bassett, K., & Kazanjian, A. (1999, May). *Joint health technology assessment series: A systematic review and critical appraisal of the scientific evidence on craniosacral therapy*. British Columbia Office of Health Technology Assessment.

Hewitt, E. G. (1999). Chiropractic care for infants with dysfunctional nursing: A case series. *Journal of Clinical Chiropractic Pediatrics, 4*, 241-244.

Hewitt, E. G. (2004). Chiropractic care and the irritable infant. *Journal of Clinical Chiropractic Pediatrics, 6*, 394-397.

Holtrop, D. P. (2000). Resolution of suckling intolerance in a 6-month old chiropractic patient. *Journal of Manipulative and Physiological Therapeutics, 23*, 615-618.

Johnson, A. T. (2003). *Response to craniosacral therapy in an infant with plagiocephaly*. Unpublished master's thesis, Western Michigan University, Kalamazoo.

Joyce, P., & Clark, C. (1996). The use of craniosacral therapy to treat gastroesophageal reflux in infants. *Infants and Young Children, 9*(2), 51-58.

Katz, L. (1998). *Coaching children in developmental progress: Upledger craniosacral therapy offers a base of knowledge and clinical practice to help infants and children at their primary levels of impairment*. Palm Beach Gardens, FL: Upledger Institute.

Kern, M. (2001). *Wisdom in the body: The craniosacral approach to essential health*. London: Thorsons.

Lumpkin, G. G. (2002). *Children's application page*. Denver, CO: Author. Retrieved March 3, 2003, from http://www.cranialintegration.com/apps/children.html

Marohn, S. (2002). *The natural medicine guide to autism*. Charlottesville, VA: Hampton Roads.

McCann, D. (2005, May). Mission impossible? A journey out of autism. *Fulcrum*(35), 4-6. Retrieved April 19, 2005, from http://www.craniosacral.co.uk/

Pratkanis, A., Eskanazi, J., & Greenwald, A. (1994). What you expect is what you believe (but not necessarily what you get): A test of the effectiveness of subliminal self-help audiotapes. *Basic and Applied Social Psychology, 15*, 251-276.

Rosenbaum, P. L., & Law, M. (1996). Craniosacral therapy and gastroesophageal reflux: A commentary. *Infants and Young Children, 9*(2), 69-74.

Vail, B. B. (1993, October). *Evaluation and cranial treatment of the pediatric patient with sagittal suture synostosis: A case report*. Paper presented at the National Conference on Chiropractic and Pediatrics, Palm Springs, CA and Palm Beach, FL.

Van Loon, M. (1998). Colic with projectile vomiting: A case study. *Journal of Clinical Chiropractic Pediatrics, 3*, 207-210.

Woods, R. H. (1973). Structural normalization in infants and children with particular reference to disturbances of the central nervous system. *Journal of the American Osteopathic Association, 72*, 903-908.

Yin, R. K. (2000). Rival explanations as an alternative to reforms as "experiments". In L. Bickman (Ed.). *Validity and social experimentation: Donald Campbell's legacy* (pp. 239-266). Thousand Oaks, CA: Sage.

Authors

Tracy L. Masiello, Ph.D. is a Research Scientist at the Orelena Hawks Puckett Institute in Asheville, North Carolina (tmasiello@puckett.org). Jennifer Pace, B. A., is a Research Assistant at the Puckett Institute (jpace@puckett.org).

Table 1
Characteristics of the Study Participants

Study	Sample Size	Child Age (months)	Child Gender		Child Diagnosis
			Male	Female	
Adler (2001)	1	5	-	1	Seizures
Arbuckle (1948) (Study 1)	1	<1	-	1	Cyanosis, weak cry, tremors, and projectile vomiting
Barnes et al. (1990) (Study 1)	1	42	-	1	Left hemiparesis
Blum (1999)	1	13	1	-	Down's syndrome
Duncan et al. (2004)	50	11-144	36	14	Cerebral palsy
Hewitt (1999) (Study 1)	1	2	-	1	Difficulty maintaining suction while breastfeeding, excessive regurgitation, and extremely fussy behavior
Hewitt (1999) (Study 2)	1	1	1	-	Unable to suckle effectively
Hewitt (2004)	1	2	-	1	Irritable, dysfunctional nursing, poor sleeping
Holtrop (2000)	1	6	1	-	Suckling intolerance
Johnson (2003)	1	5	-	1	Plagiocephaly
Joyce & Clark (1996)	1	8.5	-	1	Gastroesophageal reflux
Katz (1998)	1	14	-	1	Multiple cerebrovascular lesions
Kern (2001) (Study 1)	1	36	-	1	Ear infections and partial deafness
Kern (2001) (Study 2)	1	12	1	-	Not sitting up and floppy muscle tone
Lumpkin (2002) (Study 1)	1	17	1	-	Acute ear infection
Lumpkin (2002) (Study 2)	1	7	1	-	Acute ear infection
McCann (2005)	1	48	1	-	Autism
Vail (1993)	1	3	1	-	Dolichocephaly/sagittal suture synostosis
Van Loon (1998)	1	3	1	-	Colic and projectile vomiting
Woods (1973) (Study 2)	1	4	-	1	Medically blind

Table 2
Craniosacral Interventions, Study Designs, and Outcomes

Study	Characteristics of CST	Length of Intervention			Research Design	Outcome Measures
		Number of Weeks	Days per Week	Minutes per Day		
Adler (2001)	NR[a]	~30	1	30-45	Case study	Investigator observation Parent observation Cranial evaluation
Arbuckle (1948) (Study 1)	NR	1	2	NR	Case study	Investigator observation
Barnes et al. (1990) (Study 1)	Manipulation targeting the pelvic floor, diaphragm, latissimus dorsi, occiput, sphenoid, and dural tube	~2	5	40-60	Case study	Parent observation Therapist observation Teacher observation
Blum (1999)	Manipulation of the sphenoid and occiput	NR	NR	NR	Case study	Investigator observation
Duncan et al. (2004)	Unspecified; "craniosacral techniques"	24	NR	NR	Randomized clinical trial	Parent Interviews
Hewitt (1999) (Study 1)	Manipulation targeting the frontal, temporal, parietal and vomer bones, the occiput and sacrum	2	1	NR	Case study	Investigator observation Parent observation Physical examination
Hewitt (1999) (Study 2)	Manipulation targeting the frontal, sphenoid, and parietal bones, the occiput and the sacrum	4	4	NR	Case study	Investigator observation Parent observation Lactation consultant observation
Hewitt (2004)	Unspecified; "craniosacral therapy as described by Upledger"	3	~2	NR	Case study	Parent observation
Holtrop (2000)	Manipulation targeting the C1 vertebrae, occiput, and cranial bones	2	2	NR	Case study	Investigator observation
Johnson (2003)	Manipulation targeting the diaphragm, occiput, frontal and parietal bones, the sphenoid, and the dural tube	12	~1	NR	Case study	Investigator observation
Joyce & Clark (1996)	Upledger's Ten-Step Protocol targeting the occiput, sphenoid, temporal bones and dural membranes	~12	1	40-50	Case study	Investigator observation Parent observation
Katz (1998)	Unspecified; more than one practitioner implemented treatment in the same session	NR	NR	NR	Case study	Investigator observation
Kern (2001) (Study 1)	Unspecified; "worked with" cranial membranes and temporal bone	NR	7 total (implied)	NR	Case study	Investigator observation Parent observation Unspecified tests
Kern (2001) (Study 2)	Unspecified; "worked on" frontal bone, sphenoid bone, orbit of the right eye	NR	6 total (implied)	NR	Case study	Investigator observation Parent observation
Lumpkin (2002) (Study 1)	Unspecified; "mobilized the cranial bones"	~8	NR	NR	Case study	Parent observation
Lumpkin (2002) (Study 2)	NR	NR	2	NR	Case study	Parent observation

Table 2, continued

Study	Characteristics of CST	Length of Intervention			Research Design	Outcome Measures
		Number of Weeks	Days per Week	Minutes per Day		
McCann (2005)	Unspecified; "worked on" sacrum, lumbarsacrum region, sphenoid and cranial rhythm	~44	1-2	20	Case study	Investigator observation Parent observation
Vail (1993)	Unspecified; "cranial corrective procedures"	>52	1 per month	NR	Case study	Investigator observation Parent observation
Van Loon (1998)	Manipulation of the occiput, cervical adjustment with pediatric toggle board, thoracic adjustment, and cranial bone realignment	2	2	NR	Case study	Investigator observation
Woods (1973)	Manipulation of the sphenoid bone, frontal bones, tension balancing around the eyes	NR	NR	NR	Case study	Investigator observation Oculist observation

[a]NR = Not reported

Table 3
Major Findings and Threats to Claims about the Effectiveness of Craniosacral Therapy

Study	Major Reported Findings	Reported Relationship of CST to Child Outcomes	Major Threats and Alternative Explanations
Adler (2001)	Improved motor functioning	Not specified	Treatment fidelity Investigator bias Respondent bias Instrumentation Selection Maturation Multiple treatment interference
Arbuckle (1948) (Study 1)	Eliminated projectile vomiting Eliminated cyanosis Improved ability of infant to suck and swallow	Not specified	Treatment fidelity Investigator bias Respondent bias Instrumentation Selection
Barnes et al. (1990) (Study 1)	Increased speech Improved motor functioning Increased smiling and positive affect Improved activity and energy level	Not specified for CST component of treatment	Treatment fidelity Respondent bias Instrumentation Selection Multiple treatment interference
Blum (1999)	Eliminated bouts of chronic pneumonia Weight gain and improved respiration Decrease in chronic tachypnea	Investigator states that balancing child's cranium and thoracic diaphragm slowed tachynea and balancing CSF and cranial pulses helped child's general health.	Treatment fidelity Investigator bias Selection Multiple treatment interference
Duncan et al. (2004)	Improved leg or hand use Improved sleep patterns Increased positive affect Increased speech Improved cognitive functioning	Not specified	Treatment fidelity Respondent bias Selection Compensatory equalization of treatment
Hewitt (1999) (Study 1)	Eliminated infant fussiness Increased ability to maintain suction while nursing	Not specified	Treatment fidelity Investigator bias Respondent bias Selection
Hewitt (1999) (Study 2)	Improved ability of infant to breastfeed Infant more relaxed while breastfeeding	Not specified	Treatment fidelity Investigator bias Respondent bias Instrumentation Selection Multiple treatment interference
Hewitt (2004)	Decreased irritability Improved sleep patterns Improved ability to breastfeed	Investigator states that infant irritability may result from headache secondary to cervical or craniosacral problems that are relieved by chiropractic care and CST.	Treatment fidelity Respondent bias Selection Multiple treatment interference
Holtrop (2000)	Infant able to drink 24 ounces of formula	Investigator reports that CST may eliminate upper cervical dysfunction that might be causing a headache while sucking during breastfeeding.	Treatment fidelity Investigator bias Selection Multiple treatment interference
Johnson (2003)	Improved head shape Improved posture, balance reactions and developmental skills Eliminated incidences of gastroesophageal reflux (GSR)	Not specified	Investigator bias Respondent bias Selection Multiple treatment interference
Joyce & Clark (1996)	Eliminated gastroesophageal reflux (GSR) Improved motor functioning	Investigator indicates that GSR is the result of vagus nerve impingement and CST alleviated the impingement which, in turn, resolved child's symptoms.	Treatment fidelity Investigator bias Respondent bias Selection Multiple treatment interference

Table 3, continued

Study	Major Reported Findings	Reported Relationship of CST to Child Outcomes	Major Threats and Alternative Explanations
Katz (1998)	Eliminated need for anti-seizure medications Improved ability to chew and swallow Improved motor functioning	Not specified	Treatment fidelity Investigator bias Selection Multiple treatment interference
Kern (2001) (Study 1)	Improved sleeping patterns Improved hearing by 80% Eliminated all negative health symptoms	Not specified	Treatment fidelity Investigator bias Respondent bias Instrumentation Selection Multiple treatment interference
Kern (2001) (Study 2)	Increased positive affect Improved motor functioning	Not specified	Treatment fidelity Investigator bias Respondent bias Selection
Lumpkin (2002) (Study 1)	Eliminated symptoms of rhinitis and earaches	Investigator states that "cranial integration aids the body's healing" from trauma that occurs during a difficult birth and that causes health problems after birth.	Treatment fidelity Respondent bias Selection
Lumpkin (2002) (Study 2)	Eliminated ear infection	Investigator states that "cranial integration" aids the body's healing from trauma that occurs during a difficult birth and that causes health problems after birth.	Treatment fidelity Respondent bias Selection
McCann (2005)	Improved mood Improved eating habits Increased social interactions with other children Increased word production Able to count numbers 1 to 10 Increased eye contact	Not specified	Treatment fidelity Investigator bias Respondent bias Selection Maturation History
Vail (1993)	Improved overall symmetry and mobility of the cranium; cephalic index from 66.7 to 75.8	Not specified	Treatment fidelity Investigator bias Respondent bias Selection Maturation History Multiple treatment interference
Van Loon (1998)	Improved sleep patterns Eliminated vomiting Eliminated inconsolable crying episodes	Correction of discernable spinal and cranial dysfunctions though spinal adjusting and CST resolved all presenting symptoms.	Treatment fidelity Investigator bias Selection Multiple treatment interference
Woods (1973) (Study 2)	Improved vision	Not specified	Treatment fidelity Investigator bias Respondent bias Instrumentation Selection History Maturation