Physical Therapy
Journal of the American Physical Therapy Association

Interrater Reliability of Craniosacral Rate Measurements and Their Relationship With Subjects' and Examiners' Heart and Respiratory Rate Measurements

Virginia Wirth-Pattullo and Karen W Hayes
PHYS THER. 1994; 74:908-916.

The online version of this article, along with updated information and services, can be found online at: http://ptjournal.apta.org/content/74/10/908

Collections This article, along with others on similar topics, appears in the following collection(s):
Anatomy and Physiology: Cardiovascular/Pulmonary System
Evidence-Based Practice
Tests and Measurements

e-Letters To submit an e-Letter on this article, click here or click on "Submit a response" in the right-hand menu under "Responses" in the online version of this article.

E-mail alerts Sign up here to receive free e-mail alerts

Downloaded from http://ptjournal.apta.org/ by guest on April 26, 2012

Interrater Reliability of Craniosacral Rate Measurements and Their Relationship With Subjects' and Examiners' Heart and Respiratory Rate Measurements

Virginia Wirth-Pattullo
Karen W Hayes

Background and Purpose. *The evaluation of craniosacral motion is an approach used by physical therapists and other health professionals to assess the causes of pain and dysfunction, but evidence for the existence of this motion is lacking and the reproducibility of the results of this palpatory technique has not been studied. This study examined the interexaminer reliability of craniosacral rate and the relationships among craniosacral rate and subjects' and examiners' heart and respiratory rates.* ***Subjects.*** *Participants were 12 children and adults with histories of physical trauma, surgery, or learning disabilities. Three physical therapists with expertise in craniosacral therapy were the examiners.* ***Methods.*** *One of three nurses recorded heart and respiratory rates of both subject and examiner. The examiner then palpated the subject to determine craniosacral rate and reported the findings to the nurse. Each subject was examined by each of the three examiners.* ***Results.*** *Reliability was estimated using a repeated-measures analysis of variance and the intraclass correlation coefficient (2,1). Significant differences among examiners and the scatter plot of rates showed lack of agreement among examiners. The ICC was −.02. The correlations between subject craniosacral rate and subject and examiner heart and respiratory rates were analyzed with Pearson correlation coefficients and were low and not statistically significant.* ***Discussion and Conclusions.*** *Measurements of craniosacral motion did not appear to be related to measurements of heart and respiratory rates, and therapists were not able to measure it reliably. Measurement error may be sufficiently large to render many clinical decisions potentially erroneous. Further studies are needed to verify whether craniosacral motion exists, examine the interpretations of craniosacral assessment, determine the reliability of all aspects of the assessment, and examine whether craniosacral therapy is an effective treatment. [Wirth-Pattullo V, Hayes KW. Interrater reliability of craniosacral rate measurements and their relationship with subjects' and examiners' heart and respiratory rate measurements. Phys Ther. 1994;74:908–920.]*

Key Words: *Craniosacral therapy, Heart and respiratory rates, Palpation, Physical therapy.*

Craniosacral therapy is a relatively new evaluation and treatment approach used by a growing number of clinicians. The approach assumes the presence of craniosacral motion (sometimes called "craniosacral rhythm"), which is claimed to be an inherent rhythmical motion in humans and animals, different from any other rhythm in the body.[1] Believers in craniosacral motion contend it is a physiological motion because it is unconscious and involuntary. They also consider craniosacral motion to be stable; it purportedly does not fluctuate in response to exercise, emotion, and rest.[1] Craniosacral motion is claimed, however, to change in

Downloaded from http://ptjournal.apta.org/ by guest on April 26, 2012

response to trauma, autism, or learning disability.[1–4]

Proponents claim that the evaluation of craniosacral motion gives them an indication of restricted cranial motion and the presence of pathology anywhere in the body and can guide corrective treatment.[1] They report that craniosacral therapy produces clinical improvement in patients with pain and dysfunction.[5]

An informal debate about craniosacral therapy has recently been conducted in newsletters and magazine articles. Criticisms are based on the use of palpatory findings and the weak theoretical and research support. Evaluation of craniosacral motion is dependent on palpatory skill and training in the technique, yet therapists such as Barnes[6,7] claim that therapists can palpate cranial motion after taking only one educational course. There is skepticism about whether such a motion exists and the nature of the sensations therapists are claiming to feel. Some critics contend that therapists are really feeling the body movements that represent heart or respiratory rates or are imagining the sensation.[8–11]

Despite the criticisms, there has been little research to determine whether the motion exists, what information the evaluation of craniosacral motion provides, whether another evaluator would agree with the measurements and interpretations, whether the motion is distinct from the subject's or examiner's respiratory or heart rate, and whether treatment is truly effective. Even with the absence of research, physical therapists and other health professionals continue to palpate patients using craniosacral motion and to use the information to guide further evaluation and treatment.

The underlying assumption of craniosacral therapy is that the cranial bones move at their sutures throughout life.[1] Histological research examining the sutures of the skulls of animals and humans of various ages has found no evidence of sutural ossification.[12–17] The cranial bones allegedly move to accommodate movement of the meninges and cerebrospinal fluid (CSF). The meninges, specifically the dura mater, are said to make up the boundary of what is called the "craniosacral system." The dura mater has connections to the inner surfaces of the cranial bones and sutures and to the foramen magnum, second and third cervical vertebrae, and second sacral vertebra.[1] Proponents of craniosacral therapy state that the dura mater acts to transmit and reflect pressure or tension placed anywhere on the dura mater in many directions, including the bones to which the dura mater attaches.[1] The cranial sutures would then allow the cranial bones to move with the dura mater throughout life.

Sutherland, the founder of craniosacral therapy, thought that craniosacral motion was due to a rhythmically contracting brain or ventricular system.[18] He thought that the brain or ventricles periodically contracted, causing a rise and fall of CSF pressure. This rise and fall of pressure would in turn be transmitted and reflected throughout the dura mater and the bones to which it attaches.[1,2,19] Upledger and Vredevoogd,[1] however, proposed a "pressurestat model" to explain how craniosacral motion occurs. In the Upledger and Vredevoogd model, the CSF and the dura mater form a semiclosed hydraulic system, the shape of which is governed by fluid pressure within the membrane and by the cranial bones. Upledger and Vredevoogd suggested that CSF production by the choroid plexus is more rapid than the resorption of CSF by the arachnoid bodies within the intracranial venous system. When an upper threshold of pressure is reached, the production of CSF is turned off by some unknown hemostatic mechanism. The resorption of CSF continues to occur throughout the production phase and also while production is shut off. When CSF is not produced, the fluid pressure will drop as a result of the decreased volume within the hydraulic system. When a lower threshold of pressure is reached, CSF is again produced and the CSF pressure again rises. Upledger and Vredevoogd proposed that this change of pressure of the CSF causes a rhythmical movement that is transmitted equally in all directions within the dural boundaries. The model of Upledger and Vredevoogd is the most current assumption of how craniosacral motion occurs in the body. No research, however, has substantiated this theory.

Upledger and Vredevoogd[1] also proposed that the body fascia is continuous from head to toe and is kept in constant motion via its connections with the dura mater. Therefore, the entire body exhibits craniosacral motion, but it is reported to be especially palpable at the head. There has also been no research to support this assumption.

Two phases of motion (flexion and extension) are considered by advocates of craniosacral therapy to be palpable within the craniosacral system. Under normal circumstances, cycles of flexion and extension are reported to occur at a rate of approximately 6 to 12 cycles per minute.[1] Flexion is considered to be an extreme range of motion, during which the head becomes wider transversely and shorter in its anteroposterior

V Wirth-Pattullo, PT, is Staff Physical Therapist, Physical Therapy Ltd, 448 E Ontario, Chicago, IL 60611 (USA). This study was completed in partial fulfillment of the requirements for Ms Wirth-Pattullo's Master of Science degree at Northwestern University. Address all correspondence to Ms Wirth-Pattullo.

KW Hayes, PhD, PT, is Assistant Professor, Programs in Physical Therapy, Northwestern University Medical School, 345 E Superior, Chicago, IL 60611.

This study was approved by the Institutional Review Board of Northwestern University Medical School.

This article was submitted July 22, 1993, and was accepted May 11, 1994.

Downloaded from http://ptjournal.apta.org/ by guest on April 26, 2012

dimension. After flexion, the body is said to pass through a neutral zone on its return to the other extreme, extension, during which the head narrows and elongates anteroposteriorly. The body passes through another neutral zone on its way back to flexion. A complete cycle is composed of one flexion phase and one extension phase and normally takes about 6 seconds. Flexion is thought to occur when there is a rise in CSF pressure, with extension occurring during the fall of CSF pressure.[1] There are no data to support these assumptions. Proponents of craniosacral therapy state that the changes from flexion to extension can be palpated anywhere on the body but especially on the head (cranial vault) using various hand placements called "vault holds." Although three vault holds are taught in craniosacral therapy courses, as therapists develop expertise they often modify the vault holds depending on personal comfort and the shape and size of a patient's head.

As part of the evaluation of a patient, craniosacral therapists assess four aspects of craniosacral motion. These aspects are the rate (the number of cycles of flexion per minute), amplitude (magnitude of excursion of flexion and extension), symmetry (whether both sides of the skull demonstrate equal amplitude and rate), and quality (whether the motion is smooth or uneven).[1] If an abnormality in one or more of these aspects is felt, such as a rate of less than 6 or greater than 12 cycles per minute, the therapist will then assess the patient further and potentially treat the abnormal craniosacral motion by using specific gentle techniques. Following a treatment, the motion is again evaluated to determine whether the motion is more "normal" (Armitage P, unpublished communication, 1985).[1]

One of the foundations of craniosacral therapy is that a person who has had no history of physical trauma to his or her body should have normal motion and that craniosacral motion may be altered by any trauma, especially to the head or pelvis.[1] Proponents claim that the motion is also altered by concussion, birth trauma, dental trauma, learning disabilities, or autism.[2–4] Motion abnormalities may be manifested by a change in rate, amplitude, symmetry, or quality. Upledger,[5] for example, reported that a decrease in amplitude and an increase in rate would be found in cases of autism or inflammatory problems involving the central nervous system or meninges. Additionally, he claimed that lack of symmetry of the craniosacral motion in any area of the body can indicate local musculoskeletal pathology (such as adhesions) that causes loss of motion.

Because treatment is based on the ability to palpate craniosacral motion, it is important for therapists performing craniosacral therapy techniques on their patients to be able to palpate craniosacral motion reliably and to be able to distinguish it from other naturally occurring rhythmic motions in the body such as heart and respiratory rates. These issues have been little studied.

Upledger[20] investigated the reliability of the interpretations of several components of the craniosacral examination on 25 preschool children from a local day-care center. As part of that evaluation, the resting craniosacral rate of the subjects was assessed by Upledger and one of three other osteopaths trained in craniosacral therapy. The evaluators were blinded to each other's findings. Upledger did not report the reliability of craniosacral rate assessment, but he did provide the raw data from which an intraclass correlation coefficient (ICC[2,1])[21] could be calculated. The reliability of his data was .57, which we believe is too low to support his conclusion that the examination can be conducted with an acceptable degree of reliability.

Upledger[20] compared the craniosacral rate measurements with respiratory and heart rate measurements of both children and examiner. In 5 of 50 measurements, the craniosacral rate was within one cycle per minute of one of the other rates, leading him to conclude that the craniosacral rate was significantly different from the other rates. Upledger performed no statistical analysis, so his conclusion is not merited. Our reanalysis of his raw data produced Pearson Product-Moment Correlation Coefficients among the various rates ranging from .007 to .164. These low correlations suggest that measurements of these rates are not linearly related and that the phenomenon might be a rhythm distinct from other physiological rhythms.

Retzlaff et al[22] investigated whether the parietal bones of an adult squirrel monkey moved spontaneously and whether this movement, if present, was related to cardiac or respiratory activity. Using force-displacement transducers attached to the parietal bones, the investigators measured the oscillations of the parietal bones when the head was allowed free movement and when the head was firmly fixed. Cardiac and respiratory activity were measured using direct vessel cannulation, and all activity was recorded on a four-channel polygraph. The investigators found that, when the head was free, both parietal bones moved at a rhythm that reflected both cardiac and respiratory activity. When the head was immobilized, however, the cranial bones moved independently of each other, displaying both slow-wave and fast-wave oscillations unrelated to cardiac or respiratory activity. The authors did not attempt to explain the relationship of the bone movement with cardiac or respiratory activity and did not report the actual rates.

The investigators[22] also flexed and extended the spines of these monkeys while the animals' heads were immobilized. Increases in amplitude of movements of both parietal bones occurred during spinal movement, ceasing when spinal movement ceased. The authors concluded that the increased amplitude of movement resulted from alterations in CSF pressure. Cerebrospinal fluid pressure, however, was not measured in the study, so this conclusion is not merited. The study supports the idea that cranial bones may be capable of

Downloaded from http://ptjournal.apta.org/ by guest on April 26, 2012

spontaneous movement, at least in monkeys, and may be sensitive to other naturally occurring physiological rhythms when the head is not fixed. The study does not shed light on the mechanism of craniosacral motion.

The purpose of this study was to begin to examine the reliability and construct validity of the measurement of craniosacral motion. We examined interrater reliability of measurements of the rate of craniosacral motion on human subjects. We examined construct validity by testing the null hypotheses that there are no correlations between subject craniosacral rate and heart or respiratory rate, or between subject craniosacral rate and examiner heart or respiratory rate. If the craniosacral rate were closely related to the rates of any of these other naturally occurring rhythms, the construct validity of the measurements would not be supported.

Method

Subjects

For the convenience of the evaluators, the study was designed to be performed on a single day. The three evaluators believed that they could tolerate four sessions of 1 hour each without excessive fatigue. Twelve subjects, therefore, were recruited. To be eligible for the study, subjects were required to be over the age of 10 years, able to understand instructions, and able to lie in the supine position for 1 hour. Because craniosacral motion is claimed to be palpable on all living human subjects,[1] almost anyone could participate in this study. Subjects were recruited and selected to maximize within-group variability of craniosacral rates. In addition to subjects with unremarkable histories, subjects with a history of birth trauma; any type of surgery; major dental work; learning disability; or any traumatic accidents involving personal injury, scarring, or loss of consciousness that required medical attention were recruited from among individuals known to the investigators to have these conditions or to have experienced these events.

Table 1. *Descriptive Characteristics of Subjects (N=12)*

	n^a
Complications during birth	4
Injured in a motor vehicle accident	2
Injured in an accident other than vehicle	10
Subjects involved in more than one accident	5
Underwent surgery	10
Currently experience pain	8
Due to trauma listed above	5
No trauma	3
Had major dental work in the past	9
Currently under physician's care	4
Currently on medication	4
Has a learning disability	2

[a] Number does not total 12 because subjects appear in multiple categories.

Six male and six female volunteers participated in the study (mean age=36.6 years, SD=16.0, range=10–62). All subjects had a history of some kind of trauma. No subjects were receiving physical therapy at the time of the study. One subject had previous experience with craniosacral evaluation and treatment. Table 1 summarizes the descriptive characteristics of the subjects derived from a verbal questionnaire. Subjects signed a consent form before participating in the study.

Examiners

Three physical therapists, experienced with craniosacral therapy, were the examiners in this study. Examiner A had taken seven courses in craniosacral therapy and had used craniosacral examination and treatment on more than half of her patients for 4 years. Examiner B had taken four courses and had also used craniosacral therapy in the treatment of more than half of her patients for 4 years. Examiners A and B had been in practice with each other for 2 years. Examiner C had taken two courses, had participated in a 9-month internship with an osteopath who was trained in craniosacral therapy, and had subsequently worked closely with him for 2 years. During the following 4 years, she had treated all of her patients using craniosacral therapy. All three examiners routinely assessed craniosacral motion when treating their patients.

Research Assistants

Three nurses were research assistants in the study. Each nurse had more than 10 years of experience in taking respiratory and heart rates at least five times a week.

Procedure

All examiners and research assistants were instructed on the study procedure prior to the study. Because therapists may develop modified vault holds, the examiners were instructed to use their own specific vault hold (Fig. 1) to examine the subject's cranium. The terms "flexion" and "extension" were defined to facilitate recording the craniosacral rate in the study. To approximate usual clinical practice, no other instructions were given to the examiners regarding their methods of evaluation of craniosacral motion.

Following the initial instructions, three subjects were assigned to separate examination rooms. Each subject was asked to lie supine on the examining table for 5 minutes to stabilize his or her respiratory and heart rates. A research assistant and an examiner entered each room. Using a digital stopwatch, the research assistant took the subject's respiratory rate for 1 minute by observing and palpating chest excursion and took the heart rate for 1 minute by palpating the radial pulse. The research assistant recorded the rates as respirations per minute and heart beats per minute. During this time, the examiner sat at the head of the table facing the subject's head and rested to stabilize her heart and respiratory rates. After the

Downloaded from http://ptjournal.apta.org/ by guest on April 26, 2012

Figure 1. *Therapist demonstrating a vault hold.*

rest period, the research assistant measured the examiner's heart and respiratory rates for 1 minute. The examiner then continued to sit comfortably at the head of the table facing the subject's head with her forearms resting on the table. The examiner used her specific vault hold on the subject's cranium and had up to 2 minutes to orient herself to the cranial motion of the subject. Once the examiner was confident that she detected the cranial motion, she began to verbalize when flexion and extension were felt. The first time the examiner called out "flexion," the research assistant began timing for 1 minute and recording on an examination form each time flexion was verbalized by the examiner. Immediately following the craniosacral examination, the research assistant repeated the measurement of the subject's respiratory rate for 1 minute to determine whether it had changed following the craniosacral examination.

Although Upledger and Vredevoogd[1] claimed that craniosacral motion is stable, it was not known whether the act of palpation might change subsequent results. According to a co-worker of Upledger (William Stager; personal communication; November 15, 1991), craniosacral motion might change for a few seconds to 1 minute following palpation. To control for the possible change in the craniosacral rate from the measurement procedures, the three subjects rested quietly in the supine position for 5 minutes after the examination while the examiners and research assistants moved to different examination rooms. The entire procedure was repeated by each of the remaining two examiners. Four sets of volunteers were examined in this manner, with a 10-minute break between the second and third sets so examiners could rest. None of the examiners had knowledge of the results of any of the rates taken.

Table 2. *Mean, Standard Deviation, and Range of Craniosacral Rates (in Cycles per Minute) as Measured by Each Examiner*

	$\bar{X}$	SD	Range
Examiner A	4.50	0.80	3.0–6.0
Examiner B	5.92	1.56	3.0–9.0
Examiner C	7.00	0.95	5.0–8.0

Data Analysis

The various rates were summarized using means and standard deviations. In order to be able to generalize to other therapists, and because therapists generally assess the rate once rather than averaging several measurements, the interrater reliability was analyzed using the ICC (2,1) derived from an analysis of variance (ANOVA) for repeated measures.[21] The relationships between craniosacral rate and heart and respiratory rates were examined using Pearson Product-Moment Correlation Coefficients. For the correlations, the subjects' craniosacral rates measured by one examiner were correlated with the subjects' and the examiner's heart and respiratory rates recorded during the assessment by that examiner. For example, the craniosacral rates determined by examiner A were correlated with each subject's heart and respiratory rates measured before and after examination by examiner A and with examiner A's heart and respiratory rates. Because 15 coefficients were computed, a Bonferroni adjustment was computed, and the alpha level was set at .003.

Results

The range, mean, and standard deviation of craniosacral rates measured by each examiner are exhibited in Table 2. The lowest craniosacral rate recorded for any subject was 3 cycles per minute, and the highest craniosacral rate was 9 cycles per minute. Examiner A reported the lowest craniosacral rates on 10 of the 12 subjects,

Downloaded from http://ptjournal.apta.org/ by guest on April 26, 2012

Table 3. *Analysis of Variance Results for Three Examiners' Measurements of Subjects' Craniosacral Rate*

Source	df	SS	MS	F	P
Among subjects	11	13.64	1.24	0.90	NS
Among examiners	2	37.72	18.86	13.70	.0001
Residual error	22	30.28	1.38		
Total	35	81.64			
		ICC[a] (2,1)=−.02			

[a]ICC=intraclass correlation coefficient.

and examiner C reported the highest craniosacral rates for 7 of the 12 subjects.

Table 3 displays the results of the repeated-measures ANOVA for the three examiners palpating the rate of the craniosacral motion. There were significant differences in craniosacral rate among the three examiners. The ICC among all three examiners was −.02. There was greater variance among the examiners than among the subjects, resulting in a negative ICC. Two of the three interexaminer correlations were negative; the intercorrelation that was positive was only moderate (r_{AB}=−.33, r_{AC}=−.60, r_{BC}=.49).

Figure 2 shows the craniosacral rates for each subject measured by each examiner. Of 36 potential agreements, there were only 5 occasions on which two examiners reported the same craniosacral rate for a given subject, and an additional 11 occasions on which two examiners differed from each other by 1 cycle per minute. There were no occasions on which all three examiners agreed about the rate. The largest difference between two examiners' assessment of a single subject was 5 cycles per minute; this magnitude of difference occurred on two occasions.

Prior to examining the relationships among the various rates, the nurses' measurements of respiratory and heart rates were reviewed for their consistency. Table 4 displays the means and standard deviations of subject heart rate and subject first and second respiratory rates taken by each nurse. The data in Table 4 show that the nurses' measurements were generally similar to each other. The reliabilities of the nurses' measurements of respiratory and heart rates (ICC[2,1])[21] were .66, .82, and .76 for subject heart rate and first and second respiratory rates, respectively, and there were no systematic differences among the nurses. Reliability of examiner respiratory rate and examiner heart rate was not computed because the examiners were active between measurements of these rates.

Recognizing the nurses' measurements of heart and respiratory rates, the means of the three measurements of all rates (Tab. 5) were used in calculating the correlations among the rates. The correlations between craniosacral rate and all other rates (subject and examiner heart and respiratory rates) for each examiner are displayed in Table 6. The correlations of all variables with craniosacral rate were small and not significant, suggesting little or no linear relationship among the various rates.

Discussion

The primary purpose of this study was to estimate the interexaminer reliability of three examiners palpating the rate of craniosacral motion on human subjects. A second purpose of this study was to determine whether there were relationships among the subjects' craniosacral rate and the respiratory and heart rates of either the subjects or the examiners.

The ICC in this study was negative and must be interpreted cautiously. Negative ICCs can occur for several reasons.[23] One cause is inadequate variability in the dependent variable, indicated by a lack of statistical significance of the main effect for subjects. A main effect will not be significant if the variability among subjects is small or if the variability among raters is large. An attempt was made to provide for subject variability in the craniosacral rate by seeking subjects with varied histories of trauma and other conditions suggested to influence craniosacral motion.[1] Based on these subjects and the assumption that trauma could cause alterations in craniosacral motion,[1] a variety of normal and abnormal rates and thus more variability in craniosacral rate were expected. The measurements of craniosacral rate obtained in this study (3–9 cycles per minute) were lower than those reported by Upledger and Vredevoogd (6–12 cycles per minute),[1] but the range of rates (7 cycles per minute) was the same.

If subject variability is limited, other measures of agreement would be expected to be high if reliability were high. There were only five occasions on which two examiners reported the same craniosacral rate for a given subject, a rate of agreement of 13.9%. In light of the range of rates represented in this study and the low percentage of agreement among examiners, we believe that the usual variability is probably adequately represented in this study and that the negative ICC is due to the lack of consistency among raters.

Intraclass correlation coefficients can also be negative if there are differences in relationships among pairs of raters.[23] If the measurements of some pairs of raters are correlated negatively and others are correlated positively, the overall ICC may be negative. In our study, the rates reported by examiner A correlated negatively with both other examiners. All three

Downloaded from http://ptjournal.apta.org/ by guest on April 26, 2012

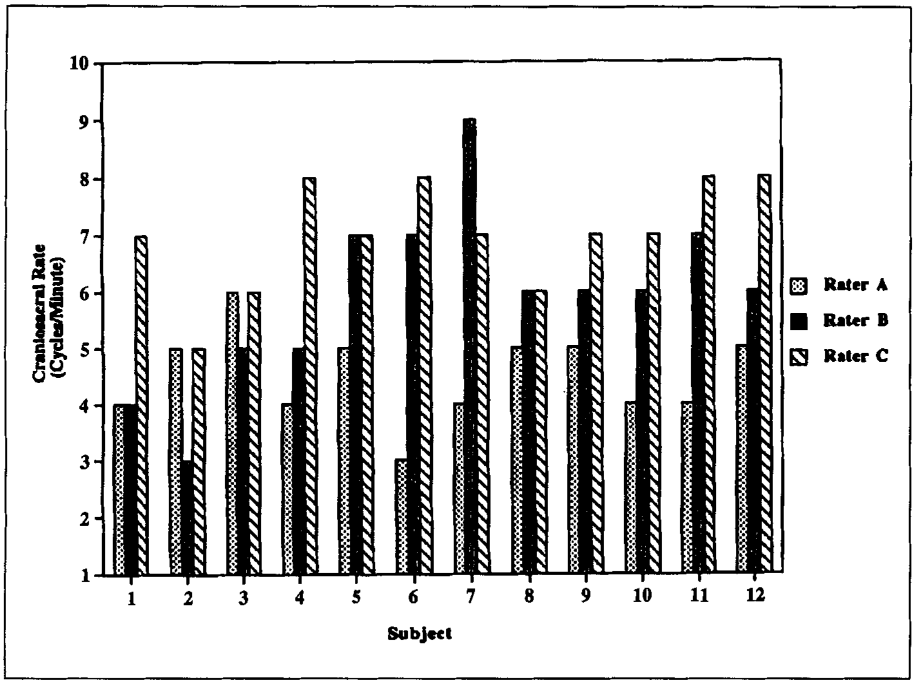

Figure 2. *Craniosacral rates of 12 subjects measured by three expert examiners.*

evaluators were equally committed to using craniosacral therapy, used the measurement method clinically in the same way it was used in this study, and were instructed about the procedure together. Although the measurements from examiner A did not relate to the measurements from the other examiners, she measured the lowest rates in 10 of the 12 subjects, which may indicate that she was using a different method of measurement.

We believe that the systematic differences among measurements of the three therapists and the wide scatter of the measurements for each subject support our conclusion that the examiners in this study were not able to palpate the craniosacral rate consistently. As a result of this inconsistency, the three examiners could have made very different judgments about whether the craniosacral rates of these subjects were normal or abnormal. Therapists presume the normal range of craniosacral rates to be 6 to 12 cycles per minute and interpret rates outside of this range to be abnormal, leading them to further evaluation and possibly treatment (if other aspects of the craniosacral motion evaluation are also abnormal).[1] Based on these two premises, examiner A would have determined 11 of the 12 subjects to have abnormal rates, examiner B would have considered 4 subjects to have abnormal rates, and examiner C would have determined only 1 subject to have an abnormal rate.

To explore the reliability further, the data from examiners B and C were used as a best-case scenario. The intercorrelations among examiners' measurements of craniosacral rates were negative for the pairs in which examiner A was a member; therefore, we computed the ICC (2,1)[21] between examiners B and C to use as a reliability estimate (ICC=.33). Using the ICC of .33 and the standard deviation from the distribution of their 24 measurements (1.1 cycles per minute), the standard error of measurement for these two therapists is ±0.90 cycles per minute, with a 95% confidence interval of ±1.76 cycles per minute. This amount of measurement error means that subjects whose craniosacral rate measurements were within about 2 cycles per minute of either end of the range considered normal (6–12 cycles per minute) would potentially be judged erroneously to have normal or abnormal rates. Nine subjects for examiner B and eight subjects for examiner C could have been subject to erroneous judgments. We believe that this level of error is too high to be acceptable for clinical decision making.

Table 4. *Means and Standard Deviations of Subjects'[a] Respiratory and Heart Rates Taken by Three Nurses*

Nurse	1st Respiratory Rate		2nd Respiratory Rate		Heart Rate	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
1	15.17	3.56	15.67	4.27	63.00	7.84
2	15.75	3.65	15.75	3.28	66.83	7.31
3	15.50	3.78	14.42	3.00	62.92	6.96
Nurses pooled	15.47	3.57	15.28	3.51	64.25	7.40

[a]N=12.

The estimate of the reliability of the rate is potentially vulnerable to measurement error resulting from the study design. There were 12 subjects in this study. Small samples do not always yield stable estimates of reliability; a larger sample may have yielded different results.

Based on the defined guidelines of counting craniosacral rate, on several occasions the nurses stopped timing just as a therapist started to verbalize the next flexion phase. None of the nurses counted the incomplete word

Downloaded from http://ptjournal.apta.org/ by guest on April 26, 2012

Table 5. *Means, Standard Deviations,[a] and Ranges[b] for Craniosacral, Heart, and Respiratory Rates (N=12)*

	$\bar{X}$	SD	Range
Subjects' craniosacral rate (cycles per minute)	5.81	0.64	3.0–9.0
Subjects' heart rate (beats per minute)	64.25	6.62	50.0–82.0
Subjects' 1st respiratory rate (respirations per minute)	15.47	3.42	8.0–22.0
Subjects' 2nd respiratory rate (respirations per minute)	15.28	3.28	9.0–23.0
Examiners' heart rate (beats per minute)	70.97	5.49	56.0–92.0
Examiners' respiratory rate (respirations per minute)	12.86	1.14	8.0–20.0

[a]Based on the mean of the three examiners' evaluations.

[b]Based on all measurements of all three examiners.

as a cycle. It is possible that if the last flexion had been counted, more of the craniosacral rate measurements would have been similar. There were only 5 occasions on which two examiners reported the same craniosacral rate for a given subject, and 16 of 36 occasions on which at least two examiners agreed or differed from each other by only one cycle, a rate of agreement of 44%. A miscounted last cycle, therefore, may have affected the outcome. A longer period of measurement, such as 3 minutes, would diminish the effect of a miscounted last cycle.

In keeping with the intent of the study to reproduce clinical conditions, the vault holds used were not consistent on any subject. The use of different vault holds is done in the clinical setting, and different vault holds are taught in any introductory course in craniosacral therapy. All therapists reported changing their hand placement as they felt the need. According to Upledger and Vredevoogd,[1] the motion is palpable all over the body, especially the head, and palpation of the motion is not dependent on the specific hold used. Therefore, using different vault holds should not have affected the results.

Insufficient preparatory time, lack of experience, and examiner fatigue would not seem to have contributed to lack of agreement among the therapists. None of the therapists required the 2 minutes allotted to palpate the motion. All three examiners had studied and practiced craniosacral therapy extensively. All therapists felt that the 10-minute rest period was adequate.

Table 6. *Correlations Between Craniosacral Rate and Other Rates*

	S-HR[b]	S-RR1[c]	S-RR2[d]	E-RR[e]	E-HR[f]
Examiner A CSR[a]	−.11	.00	−.11	.25	−.33
Examiner B CSR	−.12	−.04	−.32	.05	.00
Examiner C CSR	.34	.25	.30	.33	−.31

[a]CSR=subjects' craniosacral rate.

[b]S-HR=subjects' heart rate.

[c]S-RR1=subjects' 1st respiratory rate.

[d]S-RR2=subject 2nd respiratory rate.

[e]E-RR=examiners' respiratory rate.

[f]E-HR=examiners' heart rate.

Actual change in the phenomenon can account for low reliability. The subjects in this study were measured three times over a period of 1 hour. Measuring subjects simultaneously by more than one examiner could diminish this source of variability, but doing so would necessitate measuring the subjects at different sites, such as the head and the sacrum. Theoretically, the rates at the two sites should be the same if a subject has normal craniosacral motion (Armitage P, unpublished communication, 1985).[1] Ostensibly, the rate is easier to palpate at the head; therefore, the reliability of data taken at different sites could differ.

The reliability of craniosacral rate measurements should be further explored by studying intraexaminer reliability. Other studies examining interexaminer reliability of palpatory techniques such as static palpation of landmarks or assessment of joint play[24–31] have found low interexaminer reliability but relatively high intraexaminer reliability.

Research has not yet confirmed the existence or nature of craniosacral motion. Critics of craniosacral therapy have suggested that the motion examiners claim to feel is really the heart or respiratory rate of the subjects or examiner, but they have presented no evidence.[8–11] The correlations among measurements of craniosacral rate and heart and respiratory rates tended to be low. No discernible pattern was shown in the correlations. The same correlation was negative in some cases and positive in others, or moderate in some cases and zero in others. The lack of pattern might mean that some evaluators are influenced in some way by the subject's or their own heart or respiratory rate but other evaluators are not. The differences among the means of the various rates of the subjects and examiners (Tab. 5) may mean that the phenomenon is a distinct entity with a rate different from other physiological rates.

In spite of the apparent differences among the rates, therapists may be

Downloaded from http://ptjournal.apta.org/ by guest on April 26, 2012

feeling some sort of complex interaction among these other naturally occurring rhythms. For example, heart beats and respirations could be considered wave motions with all of the associated characteristics of wave motion, such as the production of interference patterns or harmonic frequencies. Other investigators have found relationships between the craniosacral rate and other natural frequencies. Retzlaff et al[22] found that parietal bone movement of an adult squirrel monkey reflected cardiac and respiratory activity when the head was free, as it was in our subjects. To look further at the role of interference patterns or harmonic frequencies, future studies could consider continuous measurement of the heart and respiratory rates of the examiners and subjects for detailed frequency analysis.

Craniosacral motion may not exist and might be imagined by the evaluator. The therapists knew the proposed range of rates from their continuing education courses. With this knowledge, the examiners could have been predisposed to call out flexion and extension at a rate of approximately 6 to 12 cycles per minute.

Conclusion

The focus of this study was on the interrater reliability and construct validity of the measurement of craniosacral rate of subjects with histories of physical trauma, surgery, or learning disability. The reliability was unacceptable for clinical decision making. The relationships among the measurements of craniosacral rate and other physiological rates were small and the mean rates differed, suggesting that the measurements of craniosacral rate were different from heart and respiratory rates of the subjects and therapists.

The nature of the phenomenon the physical therapists in this study were counting cannot be determined from this study. The phenomenon could be craniosacral motion as advocated by Upledger and Vredevoogd[1] and other craniosacral therapists. The phenomenon, however, could also be some complex interaction between or among other naturally occurring rhythms in the body, or the therapist's imagination. Further study involving measures of cranial bone excursion or CSF pressure using external or internal force transducers would be useful to investigate the existence and cause of craniosacral motion.

Physical therapists trained in craniosacral therapy continue to use craniosacral techniques to evaluate and treat patients. It is imperative, therefore, that more studies be done to determine the existence of craniosacral motion, the reliability of all aspects of the craniosacral examination, and the meaning of the information the examination provides.

Acknowledgments

We thank Babette Sanders, PT, and Bob Johnson, PT, OCS, for their assistance in designing this research; Clive Pai, PhD, and Mike Hage, PT, for their helpful comments on an earlier version of the manuscript; and the physical therapists, nurses, and volunteers who participated in this study.

References

1 Upledger JE, Vredevoogd JD. *Craniosacral Therapy.* Seattle, Wash: Eastland Press; 1983.

2 Mitchell FL Jr. Clinical significance of cranial suture mobility. In: Greenman PE, ed. *International Conference on Concepts and Mechanisms of Neuromuscular Functions.* Berlin, Federal Republic of Germany: Springer-Verlag; 1980:13–27.

3 Becker RE. Craniosacral trauma in the adult. *Osteopathic Annals.* 1976;4:7–8.

4 Magoun HI. The cranial concept in general practice. *Osteopathic Annals.* 1976;4:32–42.

5 Upledger JE. The therapeutic value of the craniosacral system. *Massage Therapy Journal.* Winter 1988;1–3.

6 Barnes JF. Benefits of myofascial release: craniosacral therapy explained. *Physical Therapy Forum.* 1984;3(35):1–2.

7 Barnes JF. Therapeutic insight. *Physical Therapy Forum.* 1986;5(26):1–3.

8 Becker RF. Cranial therapy revisited. *Osteopathic Annals.* 1977;5:13–40.

9 Panel debates pros and cons of myofascial release approach. *Progress Report.* 1988;17(2):10–12.

10 Panel debates pros and cons of myofascial release approach. *Progress Report.* 1988;17(3):14–18.

11 Panel debates pros and cons of myofascial release approach. *Progress Report.* 1988;17(4):15–24.

12 Pritchard JJ, Scott JH, Girgis FG. The structure and development of cranial and fascial sutures. *J Anat.* 1956;90:73–86.

13 Retzlaff EW. Structural and functional concepts of craniosacral mechanisms. In: Greenman PE, ed. *International Conference on Concepts and Mechanisms of Neuromuscular Functions.* Berlin, Federal Republic of Germany: Springer-Verlag; 1980:58–65.

14 Retzlaff EW, Michael DK, Roppel RM, Mitchell FL Jr. The structure of cranial bone sutures. *J Am Osteopath Assoc.* 1976;75:607–608.

15 Retzlaff EW, Mitchell FL Jr, Upledger JE, Biggert T. Nerve fibers and endings in cranial sutures. *J Am Osteopath Assoc.* 1978;77:474–475.

16 Retzlaff EW, Mitchell FL Jr, Upledger JE, et al. Neurovascular mechanisms in cranial sutures. *J Am Osteopath Assoc.* 1980;80:218–219.

17 Retzlaff EW, Upledger JE, Mitchell FL Jr, Walsh J. Aging of cranial sutures in humans. *Anat Rec.* 1979;193:663.

18 Sutherland AS, Wales AL, eds. *Collected Writings of William Garner Sutherland, DO, DSc (Hon) Pertaining to the Art and Science of Osteopathy Including the Cranial Concept in Osteopathy Covering the Years 1914–1954.* Boise, Idaho: Sutherland Cranial Teaching Foundation; 1967.

19 Sutherland AS. *With Thinking Fingers.* Kirksville, Mo: Journal Printing Co; 1962.

20 Upledger JE. The reproducibility of craniosacral examination findings: a statistical analysis. *J Am Osteopath Assoc.* 1977;76:890–899.

21 Shrout PE, Fleiss JL. Intraclass correlations: uses in assessing rater reliability. *Psychol Bull.* 1979;86:420–428.

22 Retzlaff EW, Michael DK, Roppel RM. Cranial bone mobility. *J Am Osteopath Assoc.* 1975;74;869–873.

23 Lahey MA, Downey RG, Saal FE. Intraclass correlations: there's more there than meets the eye. *Psychol Bull.* 1983;93:586–595.

24 Bryan JM, Mosner EA, Shippee R, Stull MA. Investigation of the flexible ruler as a noninvasive measure of lumbar lordosis in black and white adult female sample populations. *J Orthop Sports Phys Ther.* 1989;11:3–7.

25 Clarke GR. Unequal leg length: an accurate method of detection and some clinical results. *Rheumatology and Physical Medicine.* 1972;11:385–390.

26 Gonnella C, Paris SV, Kutner M. Reliability in evaluating passive intervertebral motion. *Phys Ther.* 1982;62:436–444.

27 Mann M, Glasheen-Wray M, Nyberg R. Therapist agreement for palpation and observation of iliac crest heights. *Phys Ther.* 1984;64:334–338.

28 Mior SA, McGregor M, Schut B. The role of experience in clinical accuracy. *J Manipulative Physiol Ther.* 1990;13:68–71.

29 Mootz FD, Keating JC Jr, Kontz HP, et al. Intraobserver and interobserver reliability of passive motion palpation of the lumbar spine. *J Manipulative Physiol Ther.* 1989;12:440–445.

30 Nansel DD, Peneff AL, Jansen RD, Cooperstein R. Interexaminer concordance in detecting joint-play asymmetries in the cervical spines of otherwise asymptomatic subjects. *J Manipulative Physiol Ther.* 1989;12:428–432.

31 Potter NA, Rothstein JM. Intertester reliability for selected clinical test of the sacroiliac joint. *Phys Ther.* 1985;65:1671–1675.

Downloaded from http://ptjournal.apta.org/ by guest on April 26, 2012

Physical Therapy
Journal of the American Physical Therapy Association

Interrater Reliability of Craniosacral Rate Measurements and Their Relationship With Subjects' and Examiners' Heart and Respiratory Rate Measurements
Virginia Wirth-Pattullo and Karen W Hayes
PHYS THER. 1994; 74:908-916.

Cited by	This article has been cited by 3 HighWire-hosted articles:
	http://ptjournal.apta.org/content/74/10/908#otherarticles
Subscription Information	http://ptjournal.apta.org/subscriptions/
Permissions and Reprints	http://ptjournal.apta.org/site/misc/terms.xhtml
Information for Authors	http://ptjournal.apta.org/site/misc/ifora.xhtml

Downloaded from http://ptjournal.apta.org/ by guest on April 26, 2012