Cranial findings and iatrogenesis from craniosacral manipulation in patients with traumatic brain syndrome

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Craniosacral findings were recorded for all patients with traumatic brain injury entering an outpatient rehabilitation program between 1978 and 1992. The average cranial rhythmic impulse was low in all 55 patients (average, 7.2 c/min). At least one cranial strain pattern was exhibited by 95%, and 87% had one or more bony motion restrictions. Sacral findings were similar to those in patients with low back pain. Although craniosacral manipulation has been found empirically useful in patients with traumatic brain injury, three cases of iatrogenesis occurred. The incidence rate is low (5%), but the practitioner must be prepared to deal with the possibility of adverse reactions.

(Key words: Craniosacral manipulation, traumatic brain injury, iatrogenesis, manual medicine)

Traumatic brain injury (TBI) may occur after a variety of traumatic episodes, most commonly motor vehicle accidents. A direct blow to the skull is the usual injury, but TBI can result from other impaction injuries to the body or rapid acceleration and deceleration of the trunk and neck. Patient presentations include a constellation of symptoms, such as an initial period of unconsciousness, anterograde and retrograde posttraumatic amnesia, headache, dizziness, vertigo, disorientation, and cognitive and perceptual deficits. A variety of systemic symptoms may be related to altered function of the autonomic nervous system, including nausea, vomiting, irritable bowel syndrome, hypertension, and cardiac arrhythmias. Severity ranges from mild to severe, even occasionally to a persistent vegetative state.

The exact incidence of TBI is uncertain. The entity is probably underreported. One in every 200 persons in the United States is reported to be receiving care for TBI or suffering its sequelae.[1] The incidence is approximately the same as that for stroke.

The rehabilitation of patients with TBI warrants a comprehensive, interdisciplinary team approach. The role of craniosacral manipulation as part of a comprehensive rehabilitation program has recently been described.[2]

Craniosacral manipulation was first introduced into the osteopathic medical profession in the 1930s. Instruction in the field began in the 1940s. The pioneering work of William Garner Sutherland[3] included years of research into the anatomy of the skull, clinical observation of skull mobility in normal asymptomatic patients, and abnormal cranial mobility in patients with a variety of symptoms. Sutherland evaluated the response to application of restrictive and compressive devices to the skull. He postulated the primary respiratory mechanism, consisting of five elements, as the essential components of the clinically palpable cranial rhythmic impulse (CRI) (*Table 1*).

The craniosacral system of osteopathic medicine includes a structural diagnostic process that evaluates the motility of the osseous cranium,

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the related mobility of the skull and the sacrum, and the palpation of the CRI throughout the body. Craniosacral osteopathic manipulative techniques attempt to restore motion to restrictions within individual sutures of the skull, the skull as a total entity, and the skull in relation to the sacrum, and apply inherent force to the articulations of the vertebral axis, rib cage, and extremities.

Early work in the field was based primarily on empiric clinical observations and little on research study. During the past 25 years, an increasing amount of research has helped us to understand better the components of the primary respiratory mechanism.

Anatomic studies of sutures in primates[4] and in human beings[5,6] have failed to demonstrate sutural obliteration at any age. Ligamentous structures within the sutures show a consistent fiber organization and many free nerve endings.[7] Sharpey's fibers within the sutures have a wavy contour that appears to result from the amount of stretch applied during cranial movement. Biomechanical studies of sutures in the goat revealed that bending strength and energy absorption increased with greater sutural interdigitation. The sutures were only half as strong as pure cranial bone, and did not change significantly with age.[8] One may conclude on the basis of these anatomic studies that sutures are present throughout life, and that their maintenance must require continuing motion between the related bones, with the suture as an articulation.

Physiologic studies in human beings and laboratory animals have identified motion within the living cranium. A pulse wave of the cerebrospinal fluid has been shown both intracranially and intraspinally. Choroid plexus studies have demonstrated that arterial pulsation is transferred to the cerebrospinal fluid and that blockage of the choroid may increase intracranial pressure.[9] Magnetic resonance imaging (MRI) studies have shown mobility of the brain related to the arterial pulse wave, influencing the fluctuation of cerebrospinal fluid.[10] The intracranial pulse wave is useful in monitoring cranial vasoparalysis, impaired cardiovascular activity, and cerebral edema.[11]

Cranial mobility studies have been performed in both human beings and animals. A number of different techniques have been used to demonstrate skull changes associated with the CRI and to compare it with other biologic rhythms, particularly respiration and cardiac pulse wave. The CRI was demonstrated to be different from pulse and respiration.[12,13] Similar studies on squirrel monkeys used two different measuring devices for transparietal motion.[14,15] A cyclic movement of cranial bones in the range of 5 c/min to 7 c/min was demonstrated,[14] and differed from cardiac and respiratory rates. More recent studies on the sagittal suture of cats demonstrated rotary and translatory movement.[16] The motion was altered by the application of external force and by changes in intracranial pressure associated with induced hypercapnia, intravenous norepinephrine, and the injection of artificial cerebrospinal fluid into the lateral cerebral ventricle.

A blinded comparison of x-ray patterns of plagiocephaly and clinical craniosacral examination results in 10 patients demonstrated a correlation of 0.70.[17] This study also demonstrated that declination of the occiput and sacral base correlated 0.89. Radiogrammetric measurement of anterior and posterior sacral nutation voluntary respiratory effort led to the conclusion that the sacrum nutated between the innominates as a response to respiratory effort.[18]

The amount of individual sutural mobility within the skull is quite small, but when the total skull is considered, there appears to be sufficient motion to be measurable by human palpation. A computer-driven simulator of parietal bone motion was used to test the observation of skilled clinicians and untrained persons to palpate simulated internal and external parietal rotation. These studies[19,20] showed that the accuracy of palpation was related directly to rate of motion but that decisional delay was related inversely. The perception threshold was found to be 0.5 mm/s. An interrater reliability study of 19 craniosacral characteristics in 25 healthy and symptomatic patients between two of four examiners showed an interrater reliability of 71% agreement with no rating variance.[21]

A study evaluating the CRI rate of 102 psychiatric patients and 62 healthy subjects concluded that the rate for healthy subjects averaged 12.47 c/min whereas the rate for psychotics was 6.7. The more serious the patient impairment, the lower the CRI rate.[22] In a study of 1250 infants, it was found that symptoms of vomiting, hyperactive peristalsis, tremor, hypertonicity, and irritability were more prevalent in patients with an increase in the severity of craniosacral strain patterns.[23] A study of 200 grade school children compared craniosacral restriction with a blinded psychologic and educational assessment. It concluded that there was a positive correlation between cranial motion restriction and multiple psychosocial and educational problems.[24] A 1992 study has shown the efficacy of craniosacral manipulation in the neurologic and educational development of children.[25]

Interest in craniosacral manipulation has increased rapidly in the past 50 years. This technique is now found within the armamentarium of osteopathic and allopathic physicians, chiropractors, physical therapists, massage therapists, and "body workers." Despite its extensive use, there have been no published accounts of adverse reactions. A previous report has demonstrated that improved function achieved by craniosacral manipulation correlated well with the outcome of a team program in patients with traumatic brain injury.[2] When manipulative intervention was unable to improve craniosacral function, the patient outcome was less good. The CRI rate was low and its amplitude was depressed in this population. The most common craniosacral dysfunctions were sphenobasilar compression and right lateral and right torsion strains.

Materials and methods

Cranial and sacral findings were recorded from 55 patients with histories of TBI. These represent all patients entering an outpatient rehabilitation program between 1987 and 1992. This program used a team approach: Patients interacted with physiatrists, physical therapists, occupational therapists, speech therapists, dietitians, psychologists, social workers, and an osteopathic physician with 20 years' experience in craniosacral manipulation (P.E.G.).

Cranial and sacral findings were recorded on an examination form illustrated in a previous report.[24] Variables include CRI rate (c/min) and amplitude (qualitative—normal, below normal, poor). Presence or absence of ten strain patterns in the cranium and four patterns in the sacrum were noted. Motion restrictions of the occiput and temporal, parietal, frontal, or facial bones were described. Cranial suture and synchondrosis compressions, restrictions, or tenderness were noted. Sacral restrictions were described with nomenclature delineated by Mitchell.[26] They include unilateral and bilateral flexions or extensions and anterior or posterior torsions.

Information recorded from the patients' histories included age at time of first cranial examination, time interval between examination and traumatic incident, and the mechanism of trauma. Sex and race of the patients were noted.

Table 1 Primary Respiratory Mechanism
■ Inherent motility of the brain and the spinal cord
■ Fluctuation of the cerebrospinal fluid
■ Motility of the intracranial and intraspinal membranes
■ Articular mobility of the bones of the cranium
■ Involuntary mobility of the sacrum between the ilia

Iatrogenesis is defined as very unfavorable response to therapy. Several patients had slight headaches after craniosacral therapy; these cases are not included. Three cases of iatrogenesis are reported in detail.

Results

Of the 55 patients presenting with TBI, most were female, white, and had been involved in motor vehicle accidents. Demographic information and data on the injury are presented in *Table 2*.

Cranial findings are presented in *Table 3*. All patients had a reduction in CRI rate; the average CRI rate for this population was 7.2 c/min. All but one patient also had a reduction in CRI amplitude.

Fifty-two patients (95%) had at least one cranial strain pattern. The most common patterns were lateral strains in 31 patients, followed by torsions in 30.

Fifty-two patients (95%) also had one or more bony motion restrictions. Temporal restrictions predominated. Two patients demonstrated paradoxical flexion and extension of the vomer.

Fifty-two patients (95%) had suture restrictions, with sphenobasilar synchondrosis compression and occipital-mastoid the most common (*Table 3*).

The sacrum was examined in 36 patients. Of these, 94% had motion restrictions as presented in *Table 4*. An equal number of anterior torsions (left-on-left, rarely right-on-right) and posterior torsions (left-on-left and right-on-left) were found.

Three out of 55 patients experienced iatrogenesis, an incidence rate of 5%. Their case histories follow.

Case histories

Case 1—A 33-year-old white man was first seen 30 months after injury. He had fallen approximately 15 feet, landing on his buttocks and striking the occipital area of his skull. He was unconscious for a short period. Pain developing in his lower back and radiating to the right leg was treated by facet injections, facet rhizotomies, and a coccygectomy. These interventions resulted in a 50% to 75% improvement in the back pain. He continued to complain of severe headaches, short- and long-term memory deficits, dizziness with difficulty in postural balance, and an ataxic gait. He was treated for depression for 2 years before a diagnosis of TBI was made.

Physical examination revealed an extremely ataxic gait with inability to stand on one leg without external support. The neurologic examination results otherwise were within normal limits. There was a flattened lumbar curvature with restriction of backward bending movement of the lumbar spine particularly at L-4. The right sacral base resisted anterior nutation, and the right sacrotuberous ligament was very tender with no evidence of innominate shear dysfunction. Restriction of motion was marked at the craniocervical junction, particularly the cranial base. The CRI was depressed in amplitude and rate. The left occipital mastoid suture was very tender. Attempted motion testing of the left occipital mastoid suture greatly exacerbated the patient's dizziness, so the evaluation was discontinued. The ataxic gait and dizziness increased for 4 to 6 hours after evaluation.

On subsequent evaluations, the lumbar and sacroiliac dysfunctions were addressed by application of muscle energy technique, after which lumbar extension mobility was enhanced and back pain reduced. These interventions also appeared to reduce the severity of the patient's headache.

On the third visit, the patient was able to tolerate additional evaluation of cranial mobility, which revealed marked restriction in all planes with particularly severe anteroposterior sphenobasilar compression. Motion testing through the vomer demonstrated marked restriction of motion, and any attempts at extension motion acutely exacerbated the patient's head pain. No increase in the vertiginous symptoms was encountered.

At the fourth visit, the patient's lower back pain was much improved. Treatment was directed toward the cranial dysfunction, particularly the sphenobasilar compression. Two-person decompression technique was used with no acute exacerbation of symptoms. Six hours after treatment, the patient had an increase in headache with associated nausea, vomiting, diarrhea, cardiac palpitation, and anxious respiration rate. Hospitalization was considered, but the patient wished to remain at home and responded to antiemetic and analgesic medication. The next day, the patient was free of the newer intense symptoms and noted considerable relief of head pain and beginning improvement in gait.

He continued under active treatment for 8 months, demonstrating progressive improvement in gait and reduction in dizziness and headache. At the conclusion of the active treatment plan, active motion testing of the vomer still caused pain, but it was considerably less than that at initiation. Mobility of the occipital mastoid on the left improved. Four months later, the patient was reevaluated after a blow to the head during an independent medical evaluation for Social Security disability. His gait was mildly ataxic, but he was walking 2 miles per day as part of his exercise program. Examination at this time revealed more restriction of the vomer and sphenoid, but otherwise mobility continued to be enhanced. A second exacerbation of symptoms occurred 3 months later after the extraction of a lower left third molar and an upper left first molar, resulting in increased head pain and ataxia. Examination revealed recurrent sphenobasilar compression and restricted mobility of the facial bones. Two-person sphenobasilar decompression and articular mobilization of the facial bones resulted in some posttreatment reaction. This reaction was relieved by the application of Sutherland's CV4 technique (termed "sleepy time" by Case and described by Magoun[3]), followed by membranous balance technique (also described by Magoun[3]).

When discharged from team care, the patient noticed improved balance, but some inability to stand with eyes closed. His back pain was much improved, but occasionally recurred with increased activity. Headache occasionally occurred but less severely and less frequently. The patient moved out of state for family reasons.

Case 2—A 22-year-old white man was seen 9 months after a motor vehicle accident. The patient was driving a car involved in a head-on collision. His seat belt was not in place, but the air bag inflated. His head and body struck the air bag, and his body continued over the top of the air bag with his head striking the windshield. He briefly lost consciousness. Hospital care included laceration repair of the scalp. A computed tomography (CT) scan showed a dense-signal intensity change in the left parietal occipital lobe.

The patient's initial complaints included left frontal headache, radiating toward the middle of the skull, and a sensation of "hammering" within his head. He had associated dizziness, inability to concentrate, and occasional blurring of vision. Blood pressure had recently become elevated. Analgesics and nonsteroidal anti-inflammatory agents were ineffective in controlling his headache. He received fluoxetine hydrochloride (Prozac) as an antidepressant and clonidine hydrochloride (Catapres) for the hypertension.

Physical examination results were essentially within normal limits with the exception of elevated blood pressure (140/100 mm Hg). Active motion test-

Table 2
Demographic Features in 55 Patients Treated for Intracranial Injuries

Feature	No.*
Sex	
Female	31
Male	24
Age,† yr	
Mean	34
Median	35
Range	15–68
Race	
White	52
Black	1
Hispanic	2
Time between injury and cranial examination, mo	
Mean	41
Median	22
Range	3–456
Cause of intracranial injury	
■ Motor vehicle accident	
Collision not described	10
Head-on	17
Rear-end	7
Driver's side	3
Passenger's side	3
■ Other‡	14

*Number of patients unless otherwise indicated.
†Age at time of cranial treatment.
‡Other includes the following: weight dropping on head, 4; slipping and falling to floor, 3; fall from a height, 2; being hit by moving vehicle as a pedestrian (2) or on moped (1); striking side of swimming pool, 1; hemorrhage due to arteriovenous malformation, 1.

ing in extension and rotation for vertebral artery testing resulted in nystagmus and disequilibrium. He was able to heel-and-toe walk with little difficulty, but could not stand on one leg without loss of balance. There was evidence of a short leg and pelvic tilt syndrome to the right, with a long thoracolumbar convexity to the right.

Craniosacral evaluation showed marked compression of the right condylar portion of the occiput, severe anteroposterior sphenobasilar compression, and restriction of all cranial motions, particularly left lateral strain.

Team evaluation ascertained that the patient was a candidate for the rehabilitation process, but concern was expressed that he would have to travel 1 hour by car each way to attend. The potential for symptom exacerbation after craniosacral manipulation, particularly in the presence of a recent onset of hypertension, was of particular concern. Arrangements were made with the insurance company to allow the patient to remain overnight for observation after each cranial manipulation treatment.

After the second craniosacral treatment, the insurance company discontinued reimbursement for overnight stay. The patient returned home after the subsequent treatment and had acute intensification of head pain, requiring acetaminophen with hydrocodone bitartrate (Vicodin) for symptom control. It was uncertain whether the symptom exacerbation resulted from the motor vehicle travel or the craniosacral manipulation, because previous visits had not demonstrated this effect.

At follow-up examination, the patient reported considerable alleviation of head pain, but he had developed increasingly angry thoughts and difficulty in controlling his emotions. He reported two episodes of seeing an object out of the corner of his left eye, but when turning it was not present. He felt that "somebody was watching him."

Craniosacral treatment was discontinued. Team reevaluation expressed concern about the patient's intermittent explosive behavior, increase in paranoia, and other abnormal ideations, so arrangements were made for him to receive psychiatric care at a community mental health hospital and to obtain other rehabilitation services, all closer to his home.

Case 3—A 27-year-old white man was first evaluated 11 months after he had fallen approximately 4 feet, landing on his left shoulder and the back of his head. Painful stiffness of the cervical spine and associated numbness and tingling of the left upper extremity developed. A bilateral occipital headache radiated pain over the midline vertex to the frontal regions. Symptoms were exacerbated by any increase in physical activity, particularly riding in a motor vehicle. Diagnostic studies included plain films of the cervical spine, a cervical myelogram, magnetic resonance imaging (MRI) of the head and cervical spine, and electromyographic studies of the upper extremities, all of which failed to demonstrate any organic disease.

He had been treated by extensive physical therapy, cervical epidural and occipital nerve blocks, and many forms of manipulation including manipulation under anesthesia 6 months after injury. The manipulation under anesthesia had resulted in increased range of cervical motion, but was followed by "severe total body muscle spasm," which required hospital admission and several days of intensive medication for control.

A neuropsychologic test yielded results within normal limits. Results of the physical examination, except for the biomechanical evaluation, were essentially normal. Neurologic examination results were

Table 3
Cranial Findings in 55 Patients With Intracranial Injuries

Finding	No.*
Cranial rhythmic impulse	
Reduction in amplitude	54
Reduction in rate	55
Mean rate, c/min	7.2
Strain patterns	
Flexion	20
Extension	5
Torsion, left	13
Torsion, right	17
Sidebending, left	2
Sidebending, right	9
Lateral strain, left	11
Lateral strain, right	20
Vertical strain, superior	11
Vertical strain, inferior	9
All strain patterns restricted	6
No strain patterns restricted	3
Bony motion restrictions	
■ Temporal	36
Temporal, left	9
Temporal, right	4
Temporal, bilateral	12
—Internal rotation	3
—External rotation	8
■ Occipital	28
Occipital, left	11
Occipital, right	12
Occipital, bilateral	5
—Internal rotation	3
—External rotation	8
■ Facial†	6
No bony motion restrictions	3
Suture compression or impaction	
Sphenobasilar	32
Sphenobasilar, severe	14
Occipital-mastoid	28
Sphenosquamous pivot	10
Pterion	8
Others‡	4
No suture restrictions	3

*Number of patients unless otherwise indicated.
†Facial restrictions include the following: zygomatic, 2; vomer, 2; palatine, 1; maxillary, 1.
‡Other suture compressions include the following: coronal, 2; frontal, 1; petrojugular, 1.

Table 4
Sacral Findings in 55 Patients With Intracranial Injuries

Finding	No. of patients
Impaction/compression of lumbosacral junction	3
Sacral fracture	2
Motion restriction patterns	
Flexion, left	3
Flexion, right	0
Flexion, bilateral	2
Extension, left	0
Extension, right	4
Extension, bilateral	3
Anterior torsion, left on left	9
Anterior torsion, right on right	1
Posterior torsion, left on right	6
Posterior torsion, right on left	4
Restricted in all motions	2
No restriction patterns	2
Sacrum not evaluated	19

within normal limits, except for the patient's inability to perform active cervical extension and rotation for vertebral artery testing because of very restricted cervical mobility. One-legged standing was deficient bilaterally, worse on the right, particularly with the eyes closed. Shoulder abduction was bilaterally restricted. Marked hypertonicity of all cervical musculature was present with restriction of cervical mobility in all planes, particularly extension and bilateral sidebending/rotation. It was not possible to identify segmental motion within the cervical region. Craniosacral evaluation revealed marked anteroposterior sphenobasilar compression with restriction of all cranial motion. The CRI rate was 8 c/min with low amplitude. The trunk musculature exhibited asymmetric firing patterns on hip extension.

Despite the normal findings on neuropsychologic evaluation, it was believed that the patient demonstrated significant proprioceptive deficit and possible cognitive, perceptual, and motor functional abnormalities. The left lower extremity and iliac crest were low with nonneutral lumbar behavior in left sidebending. The possibility of short leg and pelvic tilt syndrome was entertained. Cognitive, perceptual, and motor evaluation revealed significant deficits, including visual processing speed, light touch perception, kinesthetic perception, and stereognosis.

After the patient was evaluated by the chronic pain rehabilitation team, treatment was instituted. As part of the team management, craniosacral manipulation was instituted together with muscle energy technique to the upper thoracic spine. After each of the initial four treatments, the patient noticed increases in active cervical range of motion, reduction of headache, and relaxation of the tight upper extremities. Treatment was directed toward enhancement of cranial base mobility, particularly the reduction of sphenobasilar compression by two-person decompression technique.

With continued subjective and objective improvement, treatment on the fifth visit was directed at restoring symmetry of temporal bone balance and mobility. The patient responded well, but at the completion of the treatment, progressively increasing opisthotonos developed, with tonic spasms of the four extremities (*Figure*). His diaphragm was involved, and exhibited a Cheyne-Stokes respiratory pattern. This persisted despite numerous medications, including intravenous diazepam (Valium). The patient was hospitalized via ambulance. Treatment with pancuronium bromide (Pavulon), intubation, and mechanical ventilation was required to control the opisthotonos and respiratory distress. Extensive studies (including another brain MRI, electroencephalograms, and extensive neurologic evaluations) failed to demonstrate any new organic disorder. The patient was discharged 4 days later and given phenytoin sodium (Dilantin).

Two weeks afterward, he was involved in a minor motor vehicle accident, and again suffered opisthotonos with total body spasms. Repeat hospitalization required paralysis with mechanical ventilation to break the spasm. Subsequent observation at the Mayo Clinic failed to uncover any cause for the total body spasm reactions other than the craniosacral treatment.

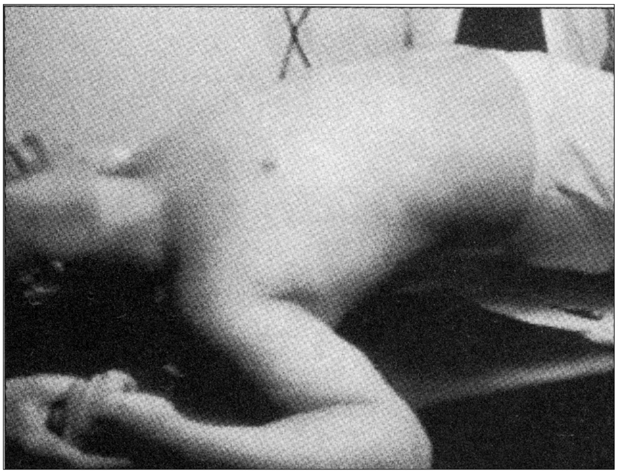

Figure. *Case 3, opisthotonos.*

Discussion

Few normative data on cranial and sacral findings have been collected. Woods and Woods,[22] who clinically examined 62 healthy adults, reported an average CRI rate of 12.47 c/min. Frymann[12] used a mechanical device recording. In one patient, the rate was 12.8 c/min. Upledger and Karni,[27] using strain gauges on an unknown number of subjects, cited a mean CRI rate between 8 c/min and 12 c/min. In 25 children, Upledger[21] reported an average CRI rate of 11.9 c/min, measured clinically.

The CRI rate of our patients with TBI averaged 7.2 c/min. Other populations with slow CRI rates include psychiatric patients (6.7 c/min, n=102)[22] and comatose persons (4.5 c/min, n=8).[28]

Becker[29] considered torsions, sidebending, and extension patterns common in normal adult crania, and flexion strains uncommon. Lateral and vertical strains he considered both uncommon and unphysiologic, the products of trauma. In our population of patients with TBI, lateral strains occurred most frequently, followed (in descending frequency) by torsions, flexions, vertical strains, sidebending strains, and last, extension strains.

A study of 1250 unselected newborn infants showed a large preponderance of torsions, followed by sidebending strains, flexion strains, and relatively few extension patterns or vertical strains.[23] In contrast, 164 normal school-aged children revealed more sidebending strains and fewer torsions, followed (in descending order) by flexion, extension, and vertical strains.[24]

Concerning bony restrictions, our 55 patients with traumatic brain injury differ little from Frymann's infants "suffering the trauma of birth." We found restrictions of temporal motion in 65% of patients, and occipital restrictions in 51%. In comparison, Frymann[23] found temporal restrictions in 71% of infants, and 61% had occipital restrictions. Among our 55 patients, two had paradoxical movement of the vomer: When the sphenoid flexed, the vomer extended, and vice versa. This finding has not been reported previously.

Our sacral findings are similar to those of patients with chronic low back pain.[30] Contrarily, Frymann[23] found sacral extension occurred 13 times as often as sacral flexion in infants, and found few torsions ("rotation between ilia"). The reasons for these differences are unknown.

(continued on page 191)

We compared characteristics of our three iatrogenic cases with those of all 55 patients, hoping to identify outstanding features. They were all white men. All three had suffered major trauma to the skull, albeit from different angles and mechanisms. The three patients differ in age and in time interval between injury and examination, but they fall within 1 SD of the group as a whole.

Craniosacral findings common to the three iatrogenic cases include low CRI amplitudes and rates, major anteroposterior sphenobasilar compressions, and right torsional strain patterns. But none of these findings is unique; they occurred in dozens of other patients who did not suffer untoward events. Thus, demographic features and craniosacral findings cannot serve as predictors for iatrogenesis.

These three cases represent a diversity of adverse reactions following craniosacral manipulation. The first patient had exacerbation of vertiginous symptoms during diagnostic evaluation alone. After sphenobasilar decompression, visceral symptoms involving cardiac, respiratory, and gastrointestinal systems arose. This feature suggests either brain stem or vagal effects as a possible source of the symptom complex. The second patient had exacerbation of headache complaint, but, more important, a disturbing psychologic/psychiatric problem, necessitating psychiatric institutional care. The severe total body spastic reaction seen in the third patient continues to defy explanation. The possibility of a brain stem seizure triggered by stimulation of the upper cervical spine and cranial base or posttraumatic cervical dystonia[31] remains plausible. Extensive evaluation failed to demonstrate a specific cause.

Each of these patients had major trauma to the skull, with severe cranial and cervical spine dysfunction. In all three instances, a major anteroposterior sphenobasilar compression with a low rate and amplitude of CRI was present. Therapeutic alteration of sphenobasilar mechanics may well have been the precipitating factor in the adverse reactions reported here.

Comment

Craniosacral manipulation is a powerful and valuable part of the manipulative medicine armamentarium. Experience has shown that it is beneficial in patients with traumatic brain injury, but is not innocuous. Even though our incidence rate of 5% is low, adverse reactions occur, and the practitioner must be prepared to deal with them. Two of our three patients required hospitalization for management. Nonphysician practitioners of manipulative treatment should have physician support available to deal with adverse reactions should they occur. Craniosacral manipulation in a traumatic brain–injured patient can be useful and effective, but is not without risk.

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