OSTEOPATHY IN THE CRANIAL FIELD: THE APPROACH OF W.G. SUTHERLAND, D.O.

RACHEL E. BROOKS, MD

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Member, Board of Trustees
Sutherland Cranial Teaching Foundation
Portland, Oregon

Reprint requests to:
Rachel E. Brooks, MD
1312 East Burnside Street
Portland, OR 97214

OSTEOPATHY AND THE CRANIAL CONCEPT

Historical Development

The science of osteopathy was put forth in 1874 by Dr. Andrew Taylor Still, a medical physician searching for a more effective system of healing than was available at the time. Still articulated a number of fundamental principles on which he based his methods of treatment.[33] He taught that the structure of the body and how it functions are reciprocally interrelated and that within each person are the self-regulating, self-healing mechanisms necessary for health. He also maintained that each person is a unit of function, with body, mind, and spirit operating as a unified whole. Osteopathy views disease and injury as involving some degree of impairment in the free flow of the material and energetic elements within the body, thereby impeding the self-correcting process within. Over time, various osteopathic manipulative approaches have been developed to apply these principles to the treatment of patients—osteopathy in the cranial field is one such approach.

In 1892, Still established the first osteopathic medical college, where William G. Sutherland enrolled in the class of 1900. While a student, Sutherland observed the cranial bones and was struck by the thought that the intricate sutures of the living cranium maintain a movement throughout life suggesting the presence of a rhythmic type of motion. This thought led to 40 years of detailed study, self-experimentation, and,

eventually, application to his patients. During that time other osteopaths were also doing important work on the function of the cranium and pelvis.[36,37] Sutherland dedicated the last 15 years of his life to teaching others this cranial concept and its practical application to patient care, which became known as ***cranial osteopathy*** or ***osteopathy in the cranial field*** (OCF).

As part of his cranial concept, Sutherland described a mechanism with five components: (1) the articular mobility of the cranial bones; (2) the mobility of the cranial and spinal dural membranes; (3) the inherent motility of the central nervous system (CNS); (4) the fluctuation of the cerebrospinal fluid (CSF); and (5) the mobility of the sacrum between the ilia. His concept, however, went far beyond the delineation of a mechanical system; it also included descriptions of the "intelligence" and "potency" of the healing forces within the body. He believed that the subtle movements he perceived were a manifestation of the basic self-regulating, self-healing mechanisms within the body in operation. Because of this mechanism's fundamental nature and its rhythmic quality, Sutherland termed it the ***primary respiratory mechanism*** (PRM), also called the ***craniosacral mechanism***.

The understanding and approach taught by Sutherland encompassed the whole body, not just the cranium. Sutherland always emphasized that the cranial concept was simply an extension of Still's science of osteopathy, extending the principles of osteopathic medicine to include the cranium. The PRM is a physiologic mechanism represented in all of body physiology. Therefore, while OCF, utilizing the inherent forces in the treatment process, is uniquely suited to treat problems in the cranium, it can also affect many situations arising from disease or trauma throughout the body.

Sutherland developed courses to teach physicians the understanding and palpatory skills necessary to treat patients in this way. In his lifetime, two organizations were established. The Sutherland Cranial Teaching Foundation is a nonprofit foundation whose objective is to promote the understanding of OCF as conceived by Sutherland. The other is The Cranial Academy (a component society of the American Academy of Osteopathy), whose mission is to teach, advocate, and advance osteopathy, specifically cranial osteopathy. An introduction to OCF is now a part of the curriculum at the osteopathic medical colleges.

Professional acceptance of the cranial concept and OCF has come slowly. This is understandable because the inherent motion present is small and not immediately perceived by most physicians. Acceptance has also been slow because many of Sutherland's fundamental concepts about the physiology of the PRM have yet to be fully substantiated. In summation of the current state of OCF, Lay wrote: "Much research remains to demonstrate the exact mechanisms involved in craniosacral dysfunction and recovery. However, more than 50 years of clinical experience has indicated that the use of osteopathy in the cranial field has given relief to many patients in whom no other treatment was effective."[19]

Learning Osteopathy in the Cranial Field

The successful practice of OCF requires more anatomic and physiologic knowledge, manual skill, and experience than most other manual treatment methods. The physician must learn the detailed anatomy of the PRM, including all the cranial sutural designs; the dura mater and its relationship to the bony, neural, and vascular structures with which it is associated; and the pathways of the cranial nerves. The physiologic understanding includes the normal motion of the PRM as a whole and of each cranial bone in particular. The physician also must know the ways in which each element of the PRM can become impaired and the resultant clinical consequences.

The development of palpatory skills is critically important. The degree of motion present that the physician must learn to feel is quite small—a smaller movement than people are accustomed to perceiving. Therefore, just as the ear is trained to hear cardiac sounds that are not ordinarily heard, the sense of touch is trained to perceive motion that is not, at first, readily apparent.

Sutherland saw his work as an integral part of osteopathic medicine, requiring the knowledge and training of a physician. The Sutherland Cranial Teaching Foundation and The Cranial Academy limit their teaching to D.O.s, M.D.s, and, in some special circumstances, dentists. OCF is a medical discipline, and those who teach it focus on establishing a solid foundation in neuroanatomy and physiology and on understanding OCF as part of a total approach to patient care. In the last 10–20 years, various other types of "cranial therapy" have arisen. Some of these courses are open to people with varying degrees of medical training. Often in these other approaches, cranial treatment is presented as a set of therapeutic techniques rather than a medical discipline.

THE PRIMARY RESPIRATORY MECHANISM

The PRM is the cornerstone of Sutherland's cranial concept. Though he described it as having five components, he emphasized that it functions as a synchronous whole. For teaching purposes, the PRM is also described as a discrete entity; however, it cannot be separated from the rest of the body. Its rhythmic, tidal movement can be palpated everywhere in the body by the trained observer. All the bones, fascia, viscera, and fluids are moving with this subtle motion throughout life. Midline structures move alternately into flexion and extension while bilateral structures move into external and internal rotation (Fig. 1). The motion of the PRM is referred to as "involuntary" and "inherent" in contrast to postural motion.

Acute physiologic states, such as fever or fatigue, can cause the rate, amplitude, and quality of this mechanism to be transiently altered. Chronic physical or emotional conditions can lower these observable parameters on a sustained basis. Whatever strains affect the PRM, all its elements continue to move in their biphasic manner, accommodating to the strain as best it can. As a palpable manifestation of the body's functioning, the PRM can be used to establish a diagnosis and monitor the effects of treatment.[1] This mechanism is also engaged in the treatment process itself. The details of its diagnostic and therapeutic use will be discussed later.

Impairments or **somatic dysfunction** involving the PRM are due to trauma, disease, or developmental factors. Trauma can produce localized or complex and diffuse dysfunctions in the PRM. Diseases that directly affect the cranial structures and contents obviously will affect the PRM. Systemic illness can affect it as well. For example, the diffuse effects of rheumatoid arthritis on the collagen tissues of the body will be felt in the PRM. An example of developmental effects on the PRM is seen in Down's syndrome, where there is an abnormality in the relationship between the embryologically discrete pre- and post sphenoid.[34]

Five Components of the Primary Respiratory Mechanism

ARTICULAR MOBILITY OF THE CRANIAL BONES

Sutherland's study began with the articular mobility of the cranial bones, this being his initial, guiding thought. He saw the detailed and unique design of each suture as being an indication of the motion present. For example, the interdigitations in the sagittal suture are wider posteriorly in the area where greater motion is perceived. The amount of motion in each suture is very small. In the PRM's flexion

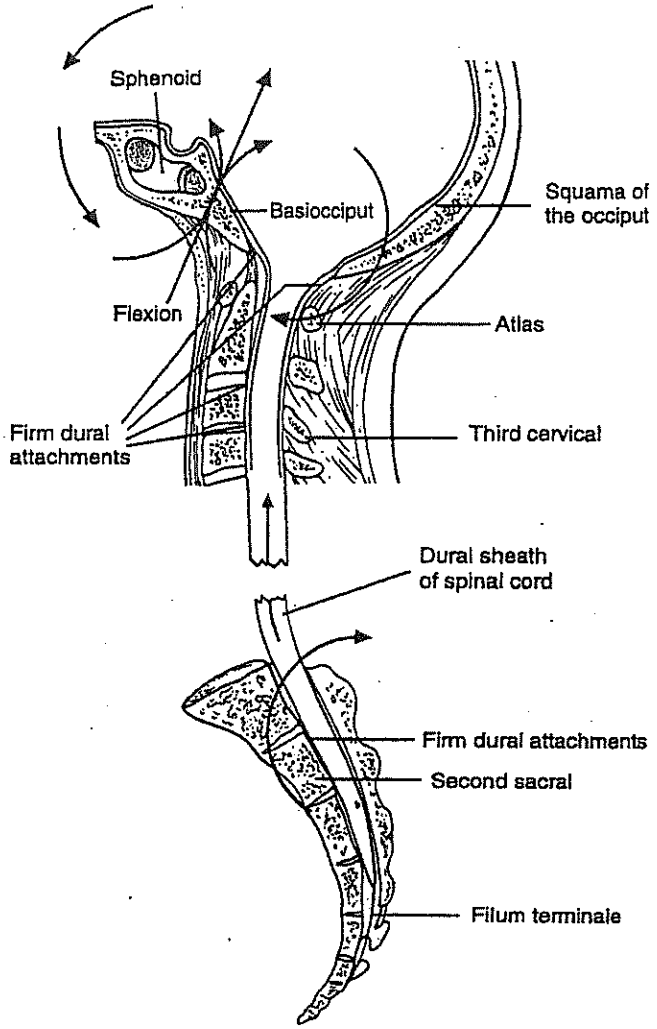

FIGURE 1. The craniosacral mechanism as it moves in the flexion phase. (From Magoun HI: Osteopathy in the Cranial Field, 3rd ed. Kirksville, MO, Journal Printing Company, 1977; with permission.)

(inhalation) phase, the cranium as a whole gets shorter in an anteroposterior direction and wider, and in extension it gets longer and narrower. Restrictions in cranial articular mobility can result from prenatal intrauterine forces, the process of labor and delivery, and subsequent trauma at any age.

Mobility of the Cranial and Spinal Dural Membranes

In joints throughout the body, the ligamentous structures serve to guide and limit the motion of the bones. Similarly, the dural membrane serves this function in the cranium. The dura mater lines the skull, forms the falx cerebri and tentorium cerebelli, and

creates the channels that form the venous sinuses. It also extends out of the cranium to form the spinal dural membrane, which attaches to the spine at various levels.[27,35] This membranous connection between the cranium and the sacrum is termed the *core-link.*

Sutherland named this dural system the *reciprocal tension membrane* (RTM) (Fig. 2). The membrane changes shape as the PRM moves, but it maintains a constant, reciprocal tension. The membrane, though pliable, is tough and nonextensible. This RTM can become strained in traumas to the body or head and affect the functioning of all the other components of the PRM. Meningeal infection can also significantly affect the condition and function of these membranes.

MOTILITY OF THE CENTRAL NERVOUS SYSTEM

In Sutherland's view the cranial bones and RTM move in order to accommodate the movement within the CNS and CSF. The CNS is described as having an inherent, rhythmic motility. In this phasic movement, the ventricles change their shape, the cerebral hemispheres coil and uncoil slightly, and the spinal cord shortens

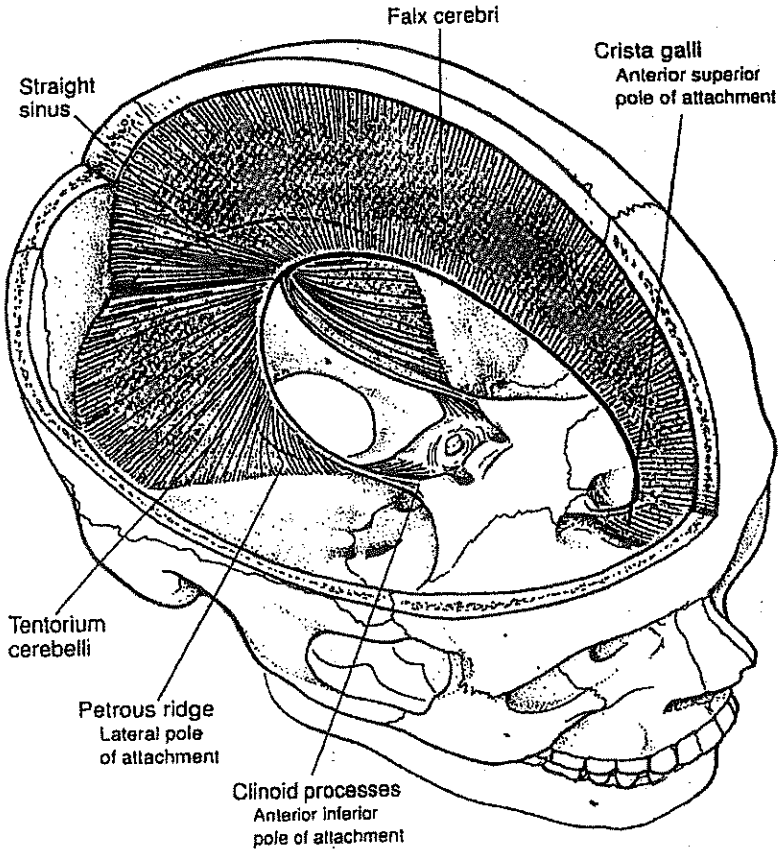

FIGURE 2. The cranial dural membrane. (From Sutherland WG, Wales AL (ed): Teachings in the Science of Osteopathy. Fort Worth, TX, Sutherland Cranial Teaching Foundation, 1990; with permission.)

and lengthens. The spinal cord and cerebral hemispheres move toward and away from lamina terminalis (the anterior wall of the third ventricle), the terminus of the embryologic CNS. The source of this inherent movement has yet to be elucidated; some role of the glial cells has been postulated.

Fluctuation of the Cerebrospinal Fluid

The CSF is formed in the choroid plexuses and moves through the ventricular system; it fills, surrounds, and supports the CNS. Much of its reabsorption occurs in the arachnoid granulations, but it is also known to make its way by various pathways into the general lymphatic circulation.[25] In addition to this directional circulation, there is a fluctuation that occurs within this fluid with a swelling and receding phase. Sutherland did not have an explanation for the CSF fluctuation, but he referred to it as the fundamental principle in the PRM. He believed it most fully embodied the life force within and was therefore a powerful tool.

Mobility of the Sacrum between the Ilia

In addition to its postural mobility, the sacrum possesses a slight rocking motion synchronous with the rhythmic movement of the PRM. In the inhalation phase, the sacral base moves posteriorly, and in the exhalation phase, the base moves anteriorly (see Figure 1). Impairment in its primary respiratory functioning can significantly affect the body in general and the PRM in particular. The sacrum is the lower pole of attachment for the dural RTM, which forms a functional core-link between the cranial and sacral regions.

Research

Studies Done

The physiologic nature of the five components of the PRM has been documented through scientific study to varying degrees. The most thoroughly supported concept is the articular mobility of the cranial bones. Anatomic studies show that sutural fusion does not ordinarily occur in adults, and physiologic studies demonstrate the cyclical movement that osteopathic physicians describe.[10,16,29–31,38–41]

The new technology of cine-magnetic resonance imaging (cine-MRI) is beginning to produce documentation of CNS motility.[5,7,24,28] Using this technology, CNS mobility in response to the arterial pulse has been recorded. In addition there has been description of a lower frequency cyclic motion of the CNS consistent with the observed 8–12 cycles-per-minute rate of the PRM. Recent studies using cine-MRI have also shown that the CSF has a "back-and-forth" movement not previously reported.[6,7,24]

Studies have supported the fact that the small amount of movement described in the skull does fall within a range palpable to the human hand.[26,32] Other studies have demonstrated a correlation between observed pathology in the PRM and clinical problems. One study examined 1250 infants and found a positive correlation between findings on clinical examination of a disturbed cranial mechanism and symptoms in newborns of vomiting, hyperactive peristalsis, tremor, hypertonicity, and hyperirritability.[9] Outcome studies have shown some benefit in children with neurologic and developmental problems[11,12] as well as in the traumatic brain injury (TBI) population.[14]

Current Research

Current research efforts have two main areas of focus. One is clinical outcomes research, and the other is basic science research aimed at an increased understanding

of the PRM. Pilot studies looking at the use of OCF in infant suckling deficiencies[8] and recurrent otitis media in children have shown positive results. A multicenter research project is currently being organized to determine clinical outcomes of osteopathic manipulative treatment of recurrent otitis media.

In September 1998, a symposium was held in which an international group of basic scientists and clinicians met to share current knowledge that could be related to the PRM and to help steer a course for further research. Future areas for basic science research were prioritized given the current capabilities of technology. In preparation for this meeting, a monograph was compiled consisting of basic science research papers pertaining to the potential for measurement of the five elements of the PRM. A book summarizing the information presented in this symposium will be published.

PRINCIPLES OF DIAGNOSIS

A thorough diagnostic understanding is very important because the osteopathic treatment program depends on this. All sources of diagnostic information are useful in the practice of OCF, although palpation ultimately is the most valuable.

History

The history should be complete as guided by the chief complaint. Areas that may require particular attention include:

- details of trauma—present and past
- birth history and neurologic development
- surgical history
- nutrition, dietary habits, and lifestyle
- mental and emotional state, trauma and abuse history

A detailed trauma history obviously is helpful when treating the effects of acute accidents, but it is also very helpful in coming to a diagnostic understanding in cases where the trauma is more remote or seemingly unrelated. A common example of this is the situation in which a patient reports an accident where there was no apparent injury, followed 6–12 months later by a first episode of acute low back pain that then becomes a chronic problem. Another example is an adult patient with chronic headaches who gives the description of a hard, sit-down fall in childhood in which he or she "saw stars." It is very likely that on palpation the practitioner will find a sacrum with very poor inherent motion and significant restrictions in the cranial base.

Observation

Observation is used to look for visible evidence of dysfunction within the PRM. The external structures can reveal the state of the mechanism. An individual with an overall flexion mechanism will have a rounder, wider head with sloping forehead, flared ears, broad cheeks, and receded chin. An overall extension mechanism will produce a long, narrow head with a more vertical forehead, non-flared ears, and prominent cheeks and chin. Departures from this pattern can indicate the strains to which the cranial mechanism is accommodating.

Particular diagnostic clues to observe in the cranium include asymmetry of the head and face, degree and trajectory of jaw motion, and unlevel ears and eyes. Plagiocephaly (asymmetry of the skull) is common in infants with a history of a difficult birth. The frequently seen "parallelogram head" deformity is associated with an underlying lateral strain of the cranial base. In observing the whole body, one

should look for scoliosis, kyphosis, head posture, habitual postures, scars, and leg length.

Palpation

The palpatory examination unique to OCF involves the assessment of the PRM. Palpation can reveal alterations in the structure and function of each of its components. The following discussion shows the type of diagnostic information available.

Tenderness or Overriding of the Sutures. Infants can show persistent overriding of one or more sutures. Patients at times report tenderness when restricted sutures are palpated.

Overall Motion in the Cranium. Cranial motion is assessed for its overall nature. Questions to be answered are: Is the motion full or limited, free or restricted, and symmetrical or asymmetrical?

Condition of the Cranial Base. The cranial base and the dural membranes associated with it can develop accommodative patterns and strains in response to external forces. Because of their effects on both the bones and membranes, Sutherland termed these *membranous articular strains*. The cranium of most people shows either a sidebending-rotation or torsion pattern, likely carried from birth or early childhood. These patterns are often well accommodated by the person, allowing for a normal range of functioning of the PRM. However, any pattern, especially if induced by significant trauma, can impede the mechanism and be an important diagnostic finding. Vertical and lateral strains are patterns that more adversely affect the integrity of the cranial base and therefore are more disruptive to the functioning of the PRM. Compression of the cranial base, with limitation in the motion between the sphenoid and occiput, is a common finding. In many patients it is mild to moderate, but it can be severe with the palpatory findings of marked restriction in overall cranial motion and a decreased quality of motion.

Motion of Individual Bones. An assessment of each cranial bone can be made for its ability to move freely. If it is restricted, some questions to ask are: Is it strained in flexion-external rotation or extension-internal rotation? Is it restricted at one or more of its articulations?

The Fluctuation of the CSF. The quality and rate of the fluctuation of the CSF are very important diagnostic clues that can be assessed. They are an indication of the health of that individual and the inherent resources available for recovery of function. A decreased rate or quality usually indicates that progress will be slower and alerts the physician to take extra care to keep the treatment within the tolerances of that patient. In a local area, the palpable altered quality of the fluid fluctuation reveals an area potentially needing treatment.

Sacral Mobility. The ability of the sacrum to move freely in its inherent, primary respiratory mobility between the ilia is a crucial assessment. It may be limited mildly to severely. If restricted, the questions are: In what directions does it move most freely? What are the effects on the functioning of the pelvis locally and the PRM as a whole? One can also gain a sense of a degree of intraosseous compression within the sacrum itself, recalling that it is made up of five segments that fuse in young adulthood.

Function in Any Area of the Body. The PRM is a part of total body physiology, and the subtle involuntary motion described in the craniosacral mechanism also occurs throughout the body. Any area of the body can be palpated for the presence and quality of this inherent motion. For example, in examining a forearm, one can palpate whether the bones with their interosseous membrane are free in this cyclic

motion or whether there is a strain present. The restriction may be significant enough to affect the quality of the fluid fluctuation in the area, and this can be palpated as well.

TREATMENT

Principles of Treatment

The distinctive approach to treatment Sutherland presented is encapsulated in his instruction to "allow physiologic function within to manifest its own unerring potency." Sutherland believed completely in the osteopathic principle of the body as a self-healing mechanism. He observed clinically that if the patient's mechanism could be facilitated into making a correction using its own inherent force rather than using an external force, the results would be both safer and potentially more profound.

Another positive consequence of having the corrective action largely arise from the patient's own mechanism is that once a change occurs, it tends to persist. There is less tendency for problems to recur. A corrective change is initiated at the time of the treatment, and the process continues for days and weeks, depending on the nature of the problem and the health of the patient. Most of the change in response to a treatment occurs between treatment sessions, and the results need to be assessed at the follow-up visit. With each subsequent treatment, the patient's mechanism makes progressively better accommodations until the strain pattern being treated is resolved.

Treatment using OCF is based on the application of principles; it is not a series of techniques. The hand placement and approaches used are based on a thorough knowledge of the anatomy and physiology of the PRM. The gentle methods Sutherland developed to treat the cranium can be applied to all structures of the body. Restrictions in bone, joints, myofascial units, other soft tissues, and fluids can be treated.

In this approach, the physician identifies the area needing treatment, applies his or her hands to address the area, brings his or her awareness to the functioning of the mechanism there, employs some small movement or pressure that brings the involved tissues into a palpable state of balance, and then supports the area to maintain that balance. Maintaining this balance usually requires some adaptive movements on the part of the physician as he or she monitors the self-corrective actions in the patient until a change occurs and the area moves toward more normal functioning. In a given treatment, usually a few to several areas are treated in this way depending on the physician's evaluation made before beginning the treatment and his or her assessment of the response during the treatment procedure.

Treatment can be applied to a very localized area or to a broad region. In the cranium, treatment can be applied to a specific suture or to the cranium as a whole. Similarly one can apply treatment in the thorax to a particular costovertebral articulation, to the scapular mechanism, or to the rib cage as a whole.

Methods of Treatment

BALANCED TENSION

The principle of balanced tension is widely applied in OCF; it is the basis of most of its treatment techniques. Simply stated, the concept describes using a manual contact and finding the point at which the sum of the palpable strain forces in the area is most neutral. Sometimes this balance in the tissues and fluids will feel

like the point of greatest ease; at other times it is a dynamic tension. Once this point of balance is attained, the physician supports the mechanism in that state of balance until a therapeutic change occurs.

Achieving Balanced Tension. The strategies employed to achieve this state of balance include exaggeration, direct action, disengagement, and opposing physiologic motion. The most commonly used is exaggeration, an indirect approach of taking the parts in the direction they go most easily, the direction of the strain. Direct action is sometimes used in very acute situations where exaggerating the lesion may not be tolerated, and direct action is the predominant strategy used in infants and children. Disengagement is particularly applied when a jamming effect has occurred in an articulation. Opposing physiologic motion, used infrequently, involves encouraging a bone in one direction and the adjacent bone in the opposite direction.

Application of Balanced Tension. The method of using balanced tension can be applied virtually to any area or component in the body. It is termed *balanced membranous tension* when it is used to treat membranous articular strains and *balanced ligamentous tension* when it is used for ligamentous articular strains.

It is critically important to treat the sacrum for its local, regional, and distal effects. A restricted sacrum is a frequent and usually overlooked factor in persistent low back pain, pelvic complaints, cervicothoracic problems from whiplash, and chronic headache. The myofascial elements also can be treated using balanced tension, including the pelvic diaphragm, thoracic diaphragm, abdominal fascia, and scapular mechanism. Treating these areas is often crucial in restoring good visceral function to the associated region.

Fluid Management

Fluid management approaches make direct use of the fluctuation of the CSF.

Compression of the Fourth Ventricle (CV4). The CV4 procedure is designed to bring the fluctuation of the CSF to an idling point in which its normal fluctuant movement is temporarily stilled. Physiologic changes from the CV4 have been recorded.[23,40] Clinically its effect is one of moving the physiology toward normalization and health. It can also be used specifically to affect the fluids of the body.

Lateral Fluctuation. In some instances the usual longitudinal direction of the tidal movement of the CSF is altered, and it becomes lateral in direction. This can occur from a blow, especially laterally, to the head or body. A lateral fluctuation is often found in association with complaints of dizziness or a generalized sense of disorientation following whiplash or concussive injuries. This situation is corrected by manually, gently guiding the fluid fluctuation out of the lateral fluctuation pattern. A lateral fluctuation technique also can be used to calm a disordered mechanism as in treatment reactions, in emotional shock, and following acute trauma.

Directing the Tide. Generally the most gentle of all the approaches, directing the tide is used commonly in the pediatric patient and in situations where there is a severe, acute condition or a very chronic, dense one. The principle is that of focusing the movement of the CSF tide into a specific area until a yielding or a softening is perceived in the area.

Contraindications and Complications

Contraindications

The lack of physical force in OCF makes it possible to use this approach in almost any circumstance. For example, severe osteoporosis and herniated discs are

not contraindications to this nonforceful approach. It can be used on the newborn from the moment of birth as well as on the frail elderly. The two described contraindications to treating the cranium are acute skull fracture and acute cerebral hemorrhage. In these instances, it is recommended that treatment be applied from the sacrum to indirectly influence the cranial mechanism.

Because patients with various injuries seek treatment with OCF, seizure disorders frequently are seen. Clinical experience has shown this condition at times can be significantly ameliorated or resolved. It is possible, however, that a seizure will be precipitated in the course of treatment. The practitioner should proceed slowly and gently in these cases to minimize this possibility.

COMPLICATIONS

No formal study of complications from the application of OCF has been undertaken. There are a few anecdotal reports of serious complication. One case of pituitary dysfunction[4] and one case of retinal detachment in proximity to cranial treatment have been described. The pituitary dysfunction resolved with further treatment. In one TBI population, 1 patient showed significant behavioral and emotional problems.[13]

It is possible to create cranial membranous articular strains through manual application. These can be mild and resolve on their own, but they can be severe in unskilled hands. Currently, a variety of "cranial techniques" is being applied by a variety of nonphysician practitioners with variable training. In one instance a forceful, thrusting type of movement was used on the cranium resulting in long-term pain and fatigue.[3]

Patient Management

COMMON TREATMENT REACTIONS

Immediately after treatment some patients feel transiently light-headed or fatigued. On occasion, patients, particularly those with chronic problems, will experience a diffuse, sore-all-over feeling that typically lasts for 1–2 days after their first treatment. On an on-going basis, a small percentage of patients report that their area of complaint typically feels worse for about a day after treatment before it starts to improve. These reactions generally are considered normal and would not suggest the need for a corrective intervention or change in treatment approach.

In regard to more significant reactions to treatment, the most common ones are nausea, dizziness, and increased pain. These symptoms usually subside on their own, but if marked in degree or persistence, they can require reevaluation by the physician. It is the rare patient who cannot tolerate OCF if the practitioner has the skills to modify treatment.

Nausea is most frequently encountered when the temporal bones or cranial-cervical (C-C) junction has been treated, with the nausea likely arising from an altered vestibular mechanism or from effects on the vagus nerve. Like nausea, dizziness can follow treatment of the temporal bones and C-C junction. These conditions usually can be resolved by restoring balance to the temporal bones, releasing the occipitoatlantal (OA) restriction, or resolving a lateral fluctuation, if present.

Some aggravation of dizziness from treatment may be unavoidable in patients where this is a current complaint or in those who had dizziness as part of their acute complex of symptoms following trauma. In these latter patients, their vestibular mechanisms have accommodated to the state created by the trauma and must reaccommodate to the corrected, normal state.

A transient, mild-to-moderate increase in a pain complaint occurs in a small number of patients and would not be considered significant. A more prolonged or severe exacerbation of pain, or one outside the area of original complaint, requires further assessment. Sometimes these exacerbations are unavoidable as changes in chronic compensatory patterns are made. For example, a patient with a very restricted sacral mechanism may develop low back pain he or she never had before during the transition time until the sacrum becomes freer.

In some cases the aggravation may be difficult to avoid. For example, patients with migraine headaches may have one triggered from work in the cervical spine. In these cases, an especially gentle approach is needed, and feedback from the patient during treatment can help the practitioner learn how to avoid these aggravations. Other instances in which the practitioner must proceed cautiously to avoid causing reactive pain are those cases with a lot of muscle or nerve irritability or where there is a lot of sympathetic tone.

Increased pain can follow treatment if a significant restriction in the pattern of somatic dysfunction is not released. For example, if the cervical and thoracic spines are treated but a first rib dysfunction is overlooked, a spasm of the shoulder girdle may occur. Increased pain can also be the result of practitioner error—it is possible to create strains through faulty application. Whether the increased pain is due to positive changes or some problem with treatment can be judged by assessing whether the patient's mechanism feels freer or more restricted.

Typical Course of Treatment

A patient's treatment program is highly individualized. At each follow-up the physician must assess the patient's current status, the response to the last treatment, the responses to any adjunctive treatments, the development of any intercurrent problems, and the need for other diagnostic or treatment strategies.

Except in very acute situations, patients typically are not seen more than once a week. Commonly patients will be seen for evaluation and treatment weekly until their symptoms ameliorate to a tolerable degree or the palpatory findings reveal evidence of improved functioning in the dysfunctional mechanism. Once this occurs, the frequency of follow-up is often tapered. The length of time this takes is totally dependent on the nature and severity of the problem and the patient's underlying state of health. An acute whiplash injury of moderate severity in a person without preexisting traumas would require on average three to twelve treatments. Patients with severe pain syndromes may require treatment at regular intervals over many months or even a few years and periodic follow-up after that to continue progress. In treating children, only a few treatments may be required to resolve a simple torticollis in an infant, while a child with major neurologic impairments would need more prolonged treatment and follow-up throughout the developmental years.

The number of treatments needed to assess the efficacy of OCF for a given patient is generally three to five, although in very chronic or severe cases it can take ten or more. Efficacy is determined in part by patient reports of diminishing symptoms and increasing function. The physician is also able to judge progress based on palpatory findings. In very chronic cases, the physician can be aware of progress occurring some time before the patient experiences symptom relief.

Adjuncts to Treatment

In some cases, OCF is the primary treatment and in other cases it is more adjunctive. Even when primary, other adjunctive approaches are often needed. The most

common are instruction in exercise and activities of daily living (ADLs). Exercise is used for strengthening, stretching, and neuromuscular or postural change. ADL instruction, with an emphasis on ergonomics and body mechanics, is used to modify causative or perpetuating factors. Other physiatric approaches such as physical and occupational therapy, medications, injections, orthotics, and acupuncture are often employed. Pain management, work hardening, and psychotherapeutic counseling are also used in conjunction with OCF. Other osteopathic treatment approaches may be used along with OCF as the physician deems appropriate.

CLINICAL APPLICATIONS

Representative clinical conditions in three categories will be presented:

1. Conditions commonly seen in physiatric practice that are uniquely suited to treatment by OCF—that is, those conditions that most specifically affect the craniosacral mechanism.
2. Conditions commonly seen in physiatric practice that respond well to OCF, but where either the craniosacral mechanism is not directly involved or its role in the dysfunction is less apparent.
3. An overview of conditions not common in physiatric practice that are commonly treated by OCF. This is done to show the reach and range of conditions responsive to this type of osteopathic treatment.

Common Physiatric Conditions Specifically Involving the Craniosacral Mechanism

HEADACHE

In patients with either tension myalgia or migraine headaches, any type of cranial finding can be seen. One common finding is of a cranial membranous articular strain creating a congestive situation. Cranial venous blood travels through sinuses composed of dural membrane and exits the skull mainly through the jugular foramina between the occiput and temporal bone. Other common restrictions in these patients include the sacrum, upper ribs, and OA joint.[17] Sometimes these noncranial findings are the most important ones in perpetuating the headache process. Prognosis in migraine headaches varies; those headaches with a cervicogenic component are probably most amenable to treatment with OCF while those that are strictly related to the menstrual cycle are less likely to respond.

LOW BACK PAIN

In addition to the myriad of myofascial, ligamentous, and articular findings that can contribute to back pain, the impaired inherent motion of the sacrum is a crucial factor and one that is routinely overlooked. Once the sacrum is released to more normal functioning, the other mechanical issues often will resolve or be more amenable to correction. This type of sacral dysfunction can also be a key factor in the failed-back syndrome.

WHIPLASH SYNDROME

All five components of the PRM can be affected by a whiplash injury as can many other parts of body physiology.[2,15] The forces involved can create a cranial membranous articular strain even if there is no direct blow to the head. The CNS and CSF fluctuation can also be affected. These PRM dysfunctions are associated with the cranial symptoms of whiplash syndrome including headache, vertigo, disequilibrium,

tinnitus, visual disturbances, and the common mental symptoms of irritability, memory deficit, and impaired information processing. Impairment of the sacrum's inherent movement is a common sequela of this type of injury and is invariably present in a persistent whiplash complaint. The nearly universal cervicothoracic strain can respond to OCF, even when in the very acute or very chronic phase, where other methods are often not tolerated or effective.

Traumatic Brain Injury

Many features of both minor and major TBI can be related to effects on the PRM. For example, vestibular dysfunction can result from imbalanced functioning between the temporal bones. Visual problems can have a number of contributing factors. The orbit, composed of seven bones, is affected by trauma to many facial and cranial structures. The extraocular muscles have attachment to three bones, and their mechanics can be affected by trauma. Membranous strains, particularly around the tentorium cerebelli's attachments in the petrosphenoid region, can cause entrapment neuropathy of cranial nerves III, IV, and VI.[17,21] Other symptoms that often respond to OCF are head pain, general irritability, and sensory overload. The response to treatment can sometimes be dramatic, and often at least some degree of improvement occurs. A clinic at Michigan State University incorporates cranial evaluation and treatment into their outpatient TBI program and has documented benefit.[14]

Post-Craniotomy

Patients with craniotomies have reported relief of symptoms of pain and irritability with cranial treatment. The same is true of those who have been treated following removal of a halo brace.

Temporomandibular Joint Syndrome and Dental Trauma

Invariably there are local cranial and cervical findings in temporomandibular joint syndrome. The problem may involve primarily the cranium itself, the relation of the maxillae and mandible, or the relation of the cranium to the cervical spine. Often there is a complex involvement of all these structures, and distant dysfunctions can play a significant role.[20] Concurrent treatment with a dental appliance or some other dental management is often necessary. Pain following dental procedures is often associated with dysfunctions in the facial structures, cranium, and cervical spine.[23] Orthodontic treatment can create strains that provoke symptoms either acutely or years later.

Torticollis

A complex of findings usually is seen in neonatal torticollis. Frequently, an associated plagiocephaly results from a cranial lateral strain. Entrapment neuropathy of cranial nerve XI as it passes through the jugular foramen is a possible contributor to sternocleidomastoid dysfunction.[22] Particular structures that require evaluation are the clavicle, condylar parts of the occiput, and temporal-occipital articulations.

Neurodevelopmental Problems

A variety of neurodevelopmental problems have shown a positive response to OCF including cerebral palsy, anoxic brain injury, and pervasive developmental delay. Generally speaking, the younger the patient, the greater the possibility for change. At times the changes are dramatic, but even when the changes are small, they can be significant, such as if a severely handicapped child is less irritable, feeds

better, or is more alert. OCF can also help to decrease seizures and spasticity and increase motor skills and sociability. The physical findings associated with these problems are unique to each individual. One common finding is of an extension mechanism that often leads to disturbed neurovegetative function, commonly affecting sleep.[9]

Other Common Physiatric Conditions Responsive to Osteopathy in the Cranial Field

FIBROMYALGIA AND MYOFASCIAL PAIN SYNDROME

While fibromyalgia and myofascial pain syndromes have many causative factors, a disturbance in the PRM is a common underlying finding. Frequently there is a markedly restricted sacrum and a cranial base compression. These dysfunctions cause problems in and of themselves as well as contribute to the generalized pattern of fascial restriction found in these patients. They often have involvement of the upper thoracic spine and ribs, which leads to a facilitated state of the sympathetic nervous system that may contribute to the characteristic muscular irritability and sleep disturbance. These patients often respond poorly to more vigorous types of manipulative treatment but usually tolerate OCF well.

PELVIC SYMPTOMS

Two common findings in pelvic pain, dysmenorrhea and stress urinary incontinence, are a result of a marked impairment of the inherent motion of the sacrum and a restricted pelvic diaphragm. The restricted sacrum is very common in pain complaints, and restriction of the pelvic diaphragm is invariably present in stress urinary incontinence.

CUMULATIVE TRAUMA DISORDER

Specific articular restrictions at the shoulder, elbow, and wrist can contribute to persistent nerve or tendon symptoms in the upper extremity. There is often involvement of the forearm's intraosseous membrane, creating a membranous articular strain. In addition, somatic dysfunction of the upper thoracic spine and thorax, with its resultant effects on sympathetic tone, is commonly present and can be a key to the resolution of the problem.

ANKLE SPRAINS

Both acute and chronic symptoms from ankle sprains can be related to localized dysfunction. In addition to the ligamentous articular strain at the ankle, a common finding is of a membranous articular strain involving the interosseous membrane with anterior displacement of the distal fibula.

Conditions Addressed in Other Medical Specialties

OCF has a variety of applications within the specialty of physical medicine and rehabilitation. Similarly there are applications within most other specialties. Accordingly, physicians practicing OCF will see a wide range of diagnoses depending on their own background and referral patterns. Common patient presentations, in addition to those described above, include infants with feeding problems or colic, children with recurrent ear infections or attention deficit disorder, and adults with sinusitis or tinnitus. In each of these conditions, a contributing dysfunction in the PRM often can be found and treated.

Because of its effects on body physiology, OCF, like osteopathy in general, can be used to assist in the treatment of conditions such as asthma, irritable bowel syndrome, and problems with hormonal regulation.[18] OCF's gentle approach makes it a particularly useful approach to treatment following acute trauma and in postsurgical and pregnant patients.

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