THE CRANIAL CONNECTION

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Dedication Page

Dedicated to
my children,
Eric and Jennifer

My thanks go to John Upledger, D.O., of The Upledger Institute and to Dan Bensky, D.O., and John O'Connor of Eastland Press for their permission to use the illustrations contained within the manuscript as well as for their editorial and textual recommendations.

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I am grateful to Michael Porvaznik, D.O., professor at the College of Osteopathic Medicine of the Pacific, and to Ted Podleski, Executive Director of the Arizona Osteopathic Medical Association, for their enthusiasm and support of this paper.

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Thanks to Ann Hermanson and Rene Faulkner for their expertise in the graphic arts.

My gratitude goes to all of my friends for their encouragement during the writing of this manuscript and during the treatment process itself, especially Marianne Boich and Joyce Little.

Finally, and most importantly, I wish to express my deepest appreciation and respect to Stephen M. Davidson, D.O., for the use of his computer and technical equipment, his continual encouragement and patience, and above all, his palpatory skills as a physician.

Carolyn Inabinet
December, 1986

This synthesis of information about Osteopathy in the Cranial Field is a concise, thorough documentation of published material. I hope that this research effort will provide a source of information for further reading as well as stimulate interest in Cranial Osteopathy.

This book contains information that can be found in various publications and is readily accessible for all to read. At the end of this book, the bibliography lists all the texts and articles reviewed for this work. Experiential knowledge is much more difficult to impart than is cognitive knowledge. It has been my own personal experience generated by consistent, progressive relief from chronic pain that has stimulated an intellectual pursuit of this field and the compilation of this manuscript.

I hope that my status of author-patient rather than author-physician will encourage those interested in discovering a therapeutic technique for treating chronic, degenerative disease processes. Any physician exposed to the possibilities Cranial osteopathy offers can develop the palpatory skills necessary for its practice.

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Note 1 : All figures with the exception of Figure 8 are adapted from CranioSacral Therapy by John E. Upledger, D.O. and Jon D. Vredevoogd, 1983, Chicago: Eastland Press. Portions of Figure 12 and Figure 13 are adapted from the same source.

Note 2 : Figure 8 is adapted from The Selected Writings of Beryl E. Arbuckle, D.O., F.A.C.O.P. by Beryl E. Arbuckle, 1977, The National Osteopathic Institute and Cerebral Palsy Foundation

List of Illustrations

"The first step in Osteopathy is a belief in our own body"
Andrew Taylor Still

An innovative and unique view of human functioning has evolved from the osteopathic philosophical foundation that acknowledges the primary importance of the living body. This paper describes a physiological system intimately involved in the body's self-regulatory process. The overall efficiency of this system has been found to assume a primary role in the treatment of disease as well as in the maintenance of health.

The philosophical foundations inherent in an osteopathic orientation should be clearly understood before introducing the cranial concept. Osteopathic thought has always placed the efficiency and/or of the living body at the center of its philosophical framework. As early as 1936, Tucker and Wilson expressed this orientation toward health and disease:

> **"The general trend of research and of therapy should be toward the body, its resources, and its reactions, rather than with the germ which has had more than its share of investigation."** (p.85)

Current medical thinking appears to be dominated by two common theories:

1) the disease theory, and
2) the external control theory.

The prevailing theory of allopathic medicine is based on a "disease theory": the study of medicine is the study of diseases which can be described, named, and classified.

> **Medical knowledge is aimed at diagnosis; treatment is dependent on accurate identification of a "disease."** (Mitchell, 1979)

Within the context of this disease theory, current treatment of disease processes all share one basic assumption: external control is necessary to treat pathology.

Knowledge of the brain has greatly expanded in the past three decades. With this increased knowledge, neuroscience is discovering new information about disease processes. However, even in such exemplary triumphs as the administration of L-Dopa for the symptoms of Parkinson's disease, the symptomatology is, at best, suppressed and the degenerative process continues. Does medicine have nothing more to offer than sophisticated diagnostic tests, labels, and newer pharmacological agents?

When pathology continues or symptoms defy diagnosis, one can either accept or reject the existing medical framework based on a *disease theory* that is dependent on external control. The focus on symptomatology and the onslaught of external agents designed to eradicate the symptoms have overshadowed the primary agent involved in the pathological state--the body itself!

> **"To say that the disease does so-and-so is incorrect for it is the *body* (italics added) that does so-and-so in the presence of an irritant."** (Tucker and Wilson, 1936, p.60)

There does exist a system of medicine that approaches pathology from a different perspective. Osteopathic medicine, while utilizing diagnostic labels and tests as well as external agents, does not limit itself to this "disease theory" in philosophy or in therapeutic technique. Nor does osteopathic medicine rely solely upon external agents to combat symptomatology.

Dr. Andrew Taylor Still, who founded of Osteopathy in post-Civil War America, formulated three general principals that illustrate the osteopathic orientation:

1) **The interrelationships between structure and function**: Normal structure helps maximize functional efficiency.

2) **The rule of the artery**: In order to function efficiently, any body part must have a continuous arterial blood supply. The degree this blood supply is compromised directly correlates with the degree to which disease begins.

3) **The inherent healing potential of the body**: Dr. Still recognized that the human body manufactures all necessary substances for the maintenance of life. If given the opportunity, the body has the capacity to heal itself. (Davidson, 1986)

The question that Dr. Still asked is relatively simple:

How does a physician stimulate this natural capacity of the body?

And the answer to this question gave birth to osteopathic medicine:

The structural alignment of the human system can stimulate normal blood flow and thereby energize the natural healing abilities of the body.

> **"'The best doctor is the one who can help Nature cure itself. '"**
> (Truhlar quoting Still, 1950, p.37)

The current decade has produced this same philosophical orientation in people other than osteopathic physicians. Dr. Andrew Weil, M.D., (1983) does an excellent job of embracing osteopathic thought in three of his nine principles of health and healing. His third principle simply restates what has already been said: the body has innate healing abilities.

> **"Healing comes from the inside, not the outside.** " (p.55)

His fourth principle is all important and again parallels osteopathic thought: agents of disease are not the cause of disease.

> **"External objects are never causes of disease, merely agents waiting to cause specific symptoms in susceptible hosts.** " (p.56)

His ninth principle again restates Dr. Still's original observations: blood is a principle carrier of healing energy.

> **"A healthy circulatory system. . . is the keystone of the body's healing system.** " (p. 61)

These ideas currently expressed by Dr. Andrew Weil were the cornerstone of osteopathic medicine as originally proposed by Dr. Andrew Taylor Still more than a century ago. Dr. Weil has simply voiced what osteopathic tradition has been saying for decades:

> **"Rather than warring on disease agents with the hope. . . of eliminating them, we ought to worry more about strengthening resistance to them. . .**" (p. 56)

The present-day crisis in battling AIDS is a case in point. All research efforts are directed at *warring on disease agents*, of finding the proper external agent to eradicate the effects of the virus. As research frantically looks for a way to combat this deadly virus, who is trying to discover a way in which to strengthen the body's resistance to the virus?

Let us change the focus from traditional allopathic medicine with its disease theory and emphasis on external control. Let us take an osteopathic orientation that emphasizes the body and considers

> " **. . . the *patient who has the disease* (italics added) and not the disease which has the patient.**" (Arbuckle, 1977, p.28)

This orientation is best exemplified by Osteopathy in the Cranial Field.

The inherent, self-regulatory potential of the body is ultimately exemplified in the craniosacral concept.

> "**Craniosacral therapy . . . throws light on the interface, or area of blending, that lies between traditional allopathic-osteopathic medicine and psychophysiologic self-regulation.** (Upledger, 1983, p. xi)

Osteopathy in the cranial field has been practiced for several decades without a complete understanding of its mechanisms. Having the potential of providing dramatic help to a significant number of *basket cases*, the results cannot be denied. Regarded by some as medical quackery and by others as divine healing, there has been a serious attempt to understand the anatomical and physiological basis of the results obtained by skillful application of craniosacral concepts. (Upledger, 1983)

The cranial concept was first conceived by a medical student at the American School of Osteopathy in Kirksville, Missouri. In 1899, William Garner Sutherland observed a disarticulated skull. An idea came to him that he was unable to dismiss in spite of his standard anatomical knowledge: the beveled articular surfaces of the sphenosquamous area were

> "**beveled like the gills of a fish: indicating articular mobility for a respiratory mechanism.**" (Sutherland, 1967, p. 102)

Finding it impossible to prove that the bones of the cranium did not move, Sutherland discovered that all the articular surfaces in the cranial joints were designed for movement; furthermore, the basic patterns of sutures were the same in every living human. (Sutherland, 1967)

Primary Respiratory Mechanism

Dr. Sutherland hypothesized a *primary respiratory mechanism* consisting of six parts:

1. Cerebrospinal fluid
2. Intracranial membranes
3. Articular mobility of cranial bones
4. Spinal cord
5. Intraspinal membranes
6. Involuntary mobility between the sacrum and ilia

The mobility between the cranial bones and between the sacrum and the ilia is not muscular in origin, but rather an involuntary movement that functions as a whole unit during respiration. (Sutherland, 1967)

The primary respiratory mechanism encompasses that fluid movement of the central nervous system that promotes physiological respiration. The control of the central nervous system over the entire body

> **"elevates the function (of the primary respiratory mechanism) to the primary position."** (Magoun, 1951, p.21)

When this primary respiratory system is altered, pathology appears in the symptoms as a disease state. This alteration is termed a *lesion*. Lesions are manifested as a loss of motion. The mobility of the cerebrospinal fluid can be impaired by disturbances in the membranous structures or by a malalignment in the osseous structures. Dysfunctions are classified as osseous, fluid, or soft tissue. (Magoun, 1951) The interdependence of each of these determines the efficiency of the whole system.

Two models illustrate this primary respiratory mechanism: a mechanical model and a pressurestat model. The dura mater plays a key role in both of these models. In the mechanical model, the dura serves as a *reciprocal tension membrane* and in the pressurestat model, the dura serves as a functional boundary of a "semi-closed hydraulic system" that houses the cerebrospinal fluid.

Mechanical Model

The mechanical model of a reciprocal tension membrane will be presented first.

As stated before, the cranial articulations have no muscular agencies for operation. There is a special membranous tissue that functions as a reciprocal tension membrane limiting the range of the mobility of the cranial bones. This tension membrane is analogous to the tension spring on the balance wheel of a watch which determines the balance wheel movement. The intracranial membranous tissue accommodates the cranial bone movement during primary respiration. (Sutherland, 1967) An understanding of this intracranial and spinal dural membrane system is mandatory in comprehending the mechanics of this system.

The boundaries of the craniosacral system are the meningeal membranes, specifically the **DURAL MEMBRANE**. The dura mater is the outermost of the meninges and is made up of two tightly attached layers except where the venous sinuses are formed. The outer layer of the dura is fused with the internal aspect of the skull as part of the cranial vault. The inner layer of the dura separates from itself at the sinuses and a space is formed for the collection of blood. (Figure 1) (Upledger, 1983)

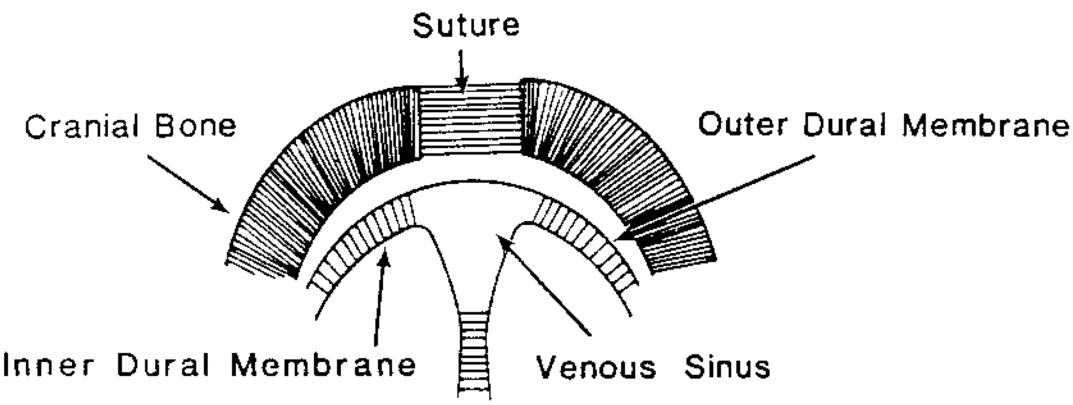


FIGURE 1
DURAL MEMBRANE

The dura fuses with itself again on the opposite side forming the non-osseous attached **INTRACRANIAL DURAL MEMBRANE SYSTEM.** This inner layer of the dura is composed of a Vertical Component (the falx cerebri and the falx cerebelli) which separates the hemispheres of the cerebrum and the cerebellum and a Horizontal Component (the tentorium cerebelli) which separates the cerebrum from the cerebellum. (Figure 2A and Figure 2B) (Upledger, 1983)

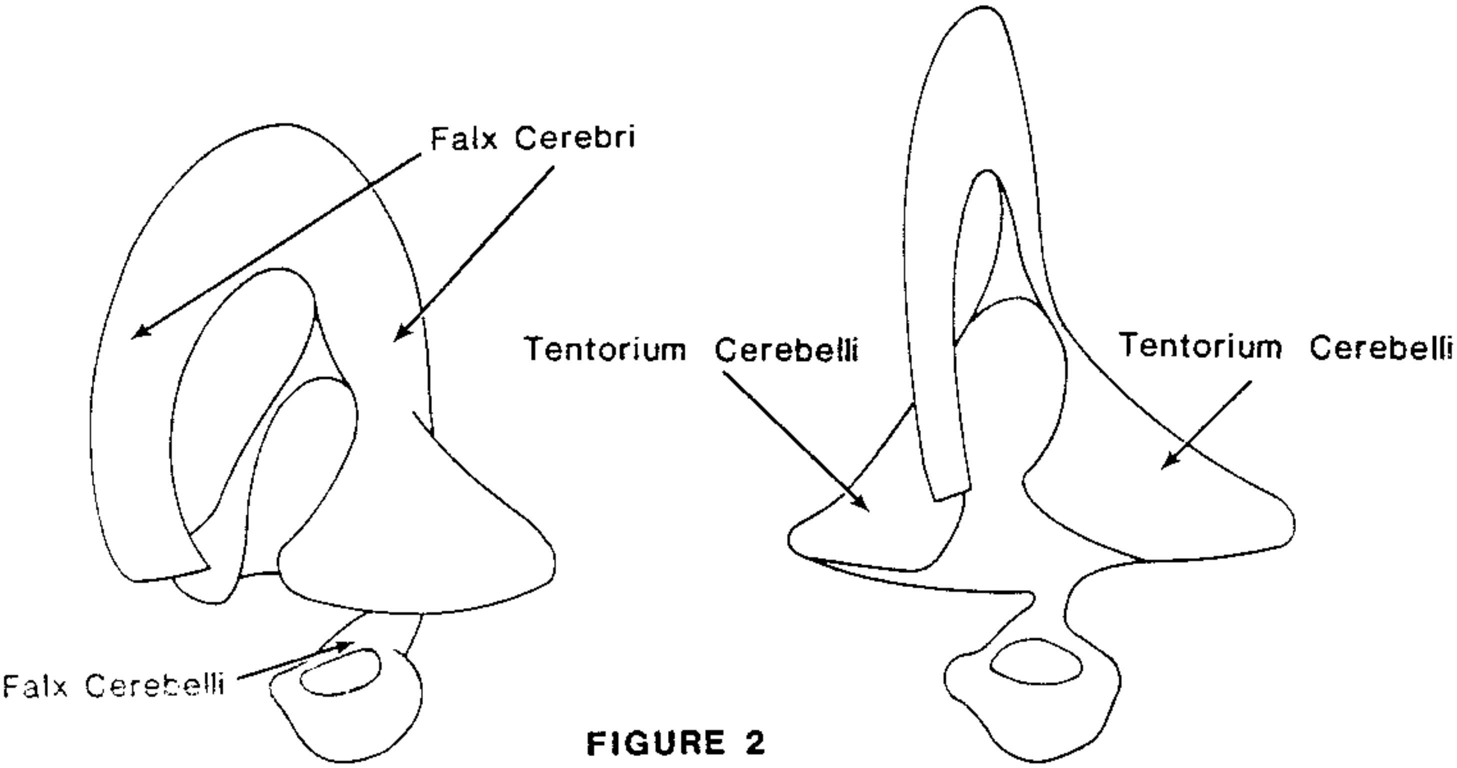


FIGURE 2
INTRACRANIAL DURAL MEMBRANE SYSTEM

FIGURE 2A
Vertical Component

FIGURE 2B
Horizontal Component

The vertical and horizontal components have specific attachments within the cranial cavity. The **ATTACHMENTS OF THE VERTICAL MEMBRANE SYSTEM** can be viewed in two parts: the falx cerebri attachments and the falx cerebelli attachments.

The sickle-shaped falx cerebri separates the cerebral hemispheres. Its superior border is attached to the midline of the skull along the frontal crest underneath the sagittal suture and extends as far posteriorly as the internal occipital protuberance. The inferior border of the falx can be divided into three parts:

1) an anterior attachment to the crista galli of the ethmoid,
2) a middle concave border housing the inferior sagittal sinus, and
3) a wide attachment to the summit of the tentorium. (Arbuckle, 1977)

Please see Figure 3A. (Upledger, 1983)

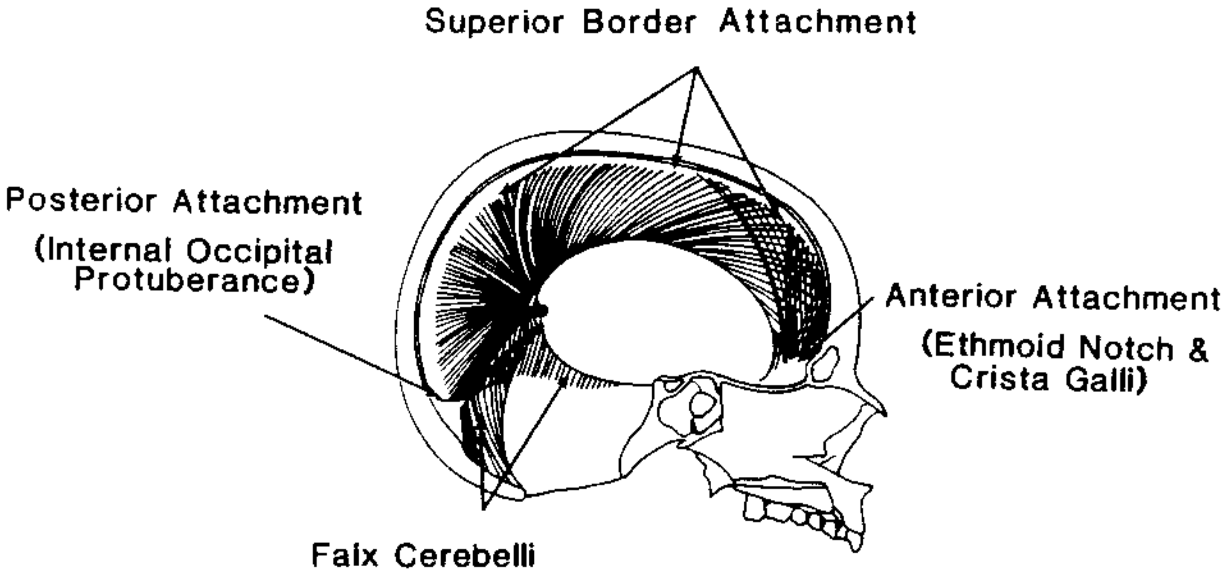


FIGURE 3A
ATTACHMENTS OF THE FALX CEREBRI

The falx cerebelli is formed from the inferior layers of the tentorium cerebelli at a medial position. The falx cerebelli extends inferiorly to the foramen magnum where it encircles this opening in the occiput with a dense fibrous ring. (Figure 3B) (Upledger, 1983)

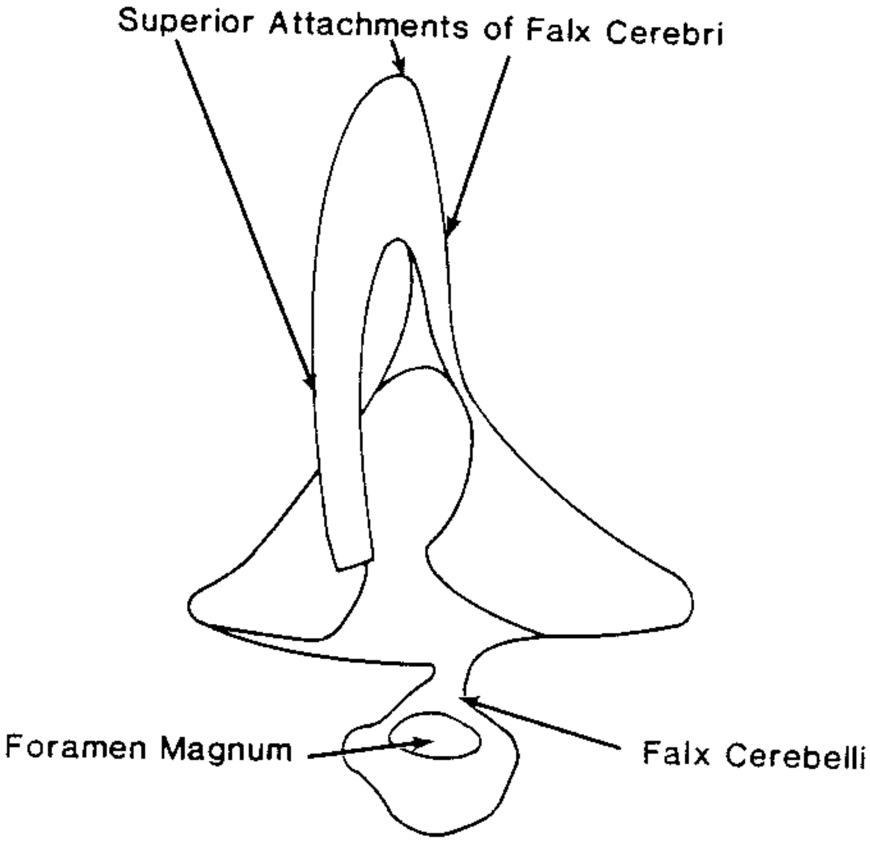


FIGURE 3B
ATTACHMENTS OF THE FALX CEREBELLI

The vertical component of the intracranial membrane system forms the **VENOUS SINUSES**: the inferior sagittal sinus, the superior sagittal sinus, the straight sinus. (Figure 4) (Upledger, 1983)

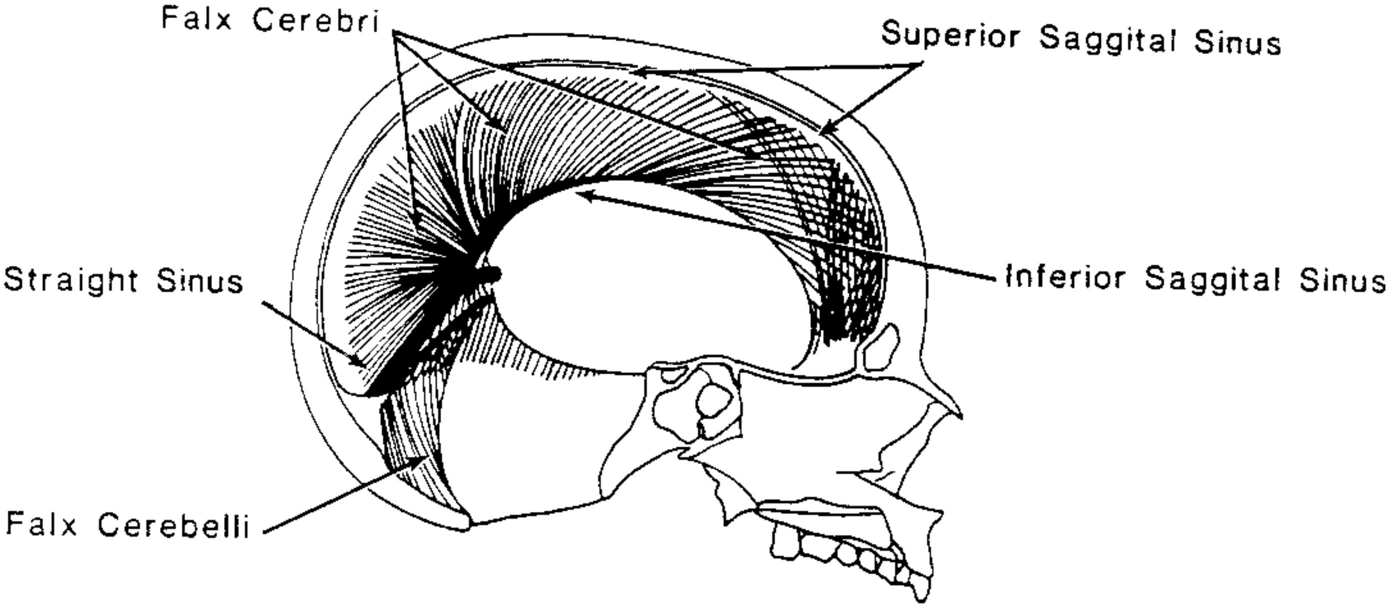


FIGURE 4
VENOUS SINUSES

The tentorium cerebelli attaches firmly in four places within the cranium:

1. to the clinoid processes of the sphenoid bone
2. to the petrous ridges and the mastoid portions of the temporal bones
3. to the posterior angle of the parietal bones
4. to the transverse ridges of the occiput.

These attachments form the **HORIZONTAL INTRACRANIAL MEMBRANE SYSTEM.** This horizontal intracranial membrane system also forms the venous sinuses. (Figure 5) (Upledger, 1983)

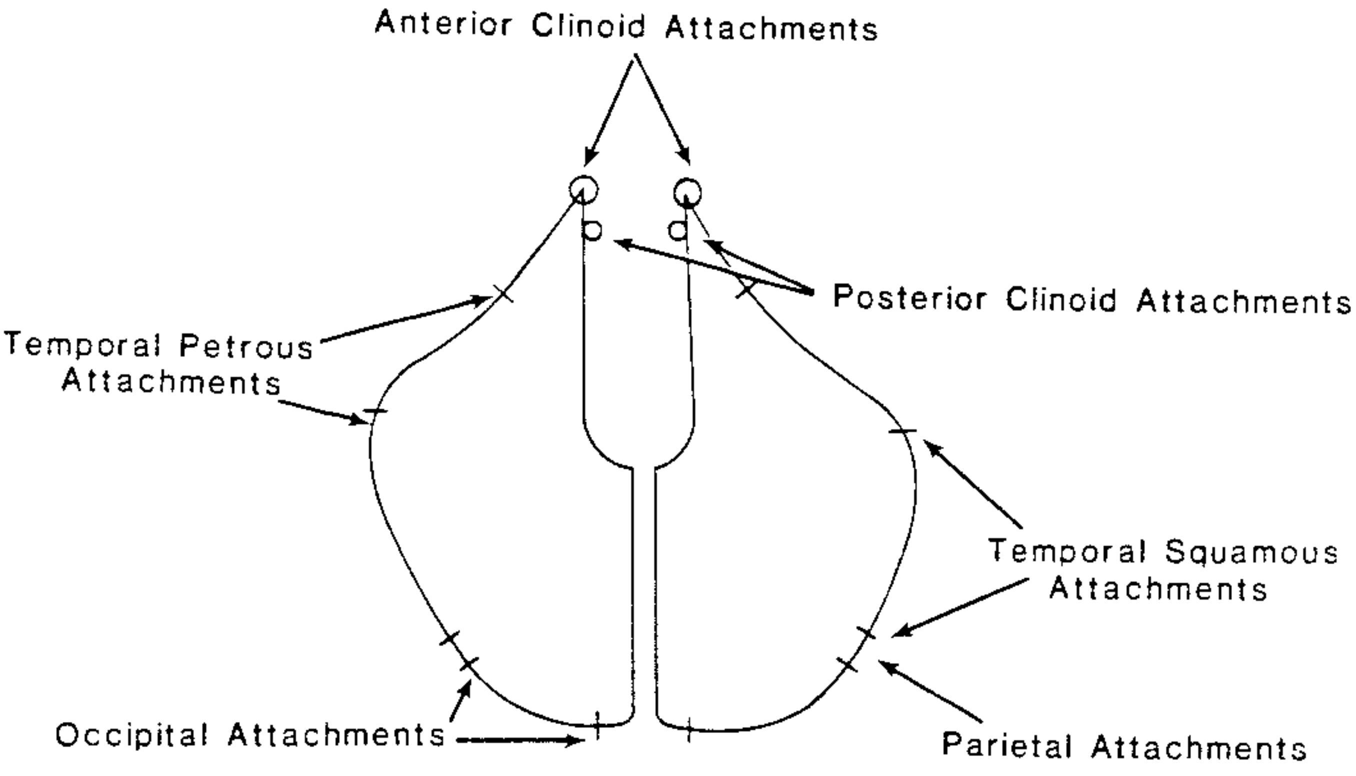


FIGURE 5

ATTACHMENTS OF THE HORIZONTAL MEMBRANE SYSTEM

The three intracranial membranes (the falx cerebri, the falx cerebelli, and the tentorium cerebelli) are joined together at the straight sinus. The junction at the straight sinus has been called the **SUTHERLAND FULCRUM** in honor of William Garner Sutherland. This conceptual model, described as a *suspension-automatic-shifting-fulcrum,* can thus physiologically adapt to postural changes. (Sutherland, 1967) (Figure 6) (Upledger, 1983)

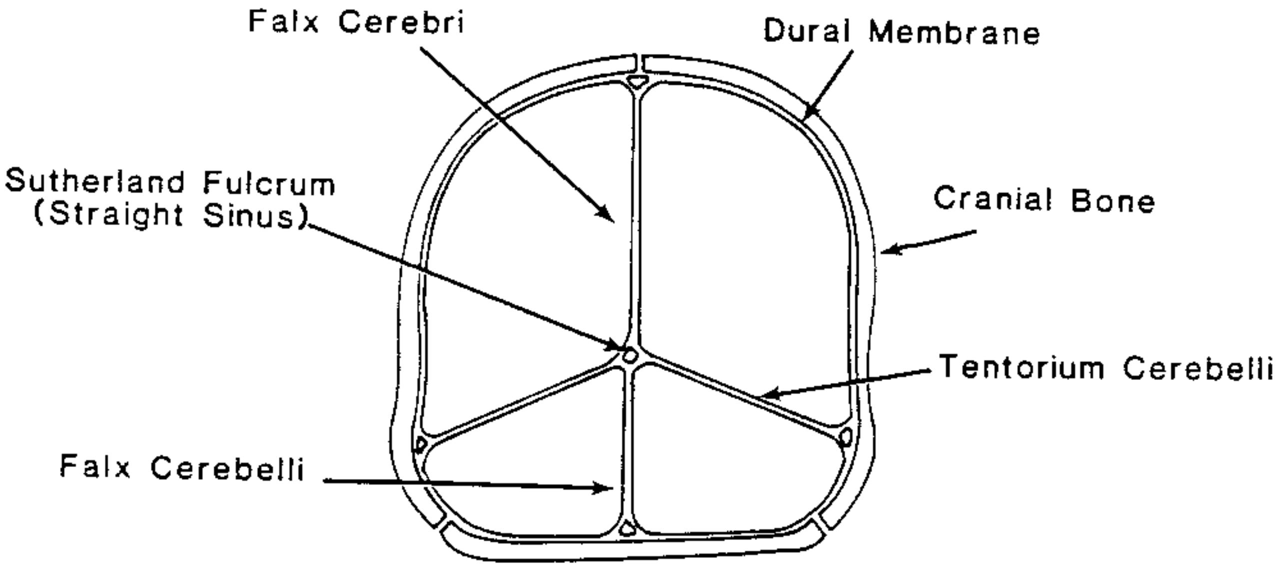


FIGURE 6
SUTHERLAND FULCRUM

The dura mater connects the occiput with the sacrococcygeal bony complex. As this spinal dural membrane passes through the vertebral canal, it forms a loose sheath for the spinal cord. This spinal dural membrane is an extension of the inner layer of the intracranial dura mater and is referred to as the dural tube. These attachments are of the dura to the bone within the vertebral canal. There are only four areas of osseous attachment in the dural tube:

1) the entire circumference of the foramen magnum,
2) the posterior aspect of the body of the second cervical vertebra,
3) the posterior aspect of the body of the third cervical vertebra and
4) the second sacral segment.

Under normal conditions, movement of the occiput results in movement of the sacrococcygeal bony complex and movement of the sacrococcygeal bony complex produces movement of the occiput. Longitudinal gliding is possible due to the relative freedom of movement of the dural tube through the vertebral canal. Thus, restricted motion of the occiput or the sacrococcygeal bony complex can produce symptoms at both ends of the spinal dural mater. The foramen magnum and sacrococcygeal bony complex are functionally connected in a vertical system via the **DURAL TUBE CONTINUITY.** (Figure 7) (Upledger, 1983)

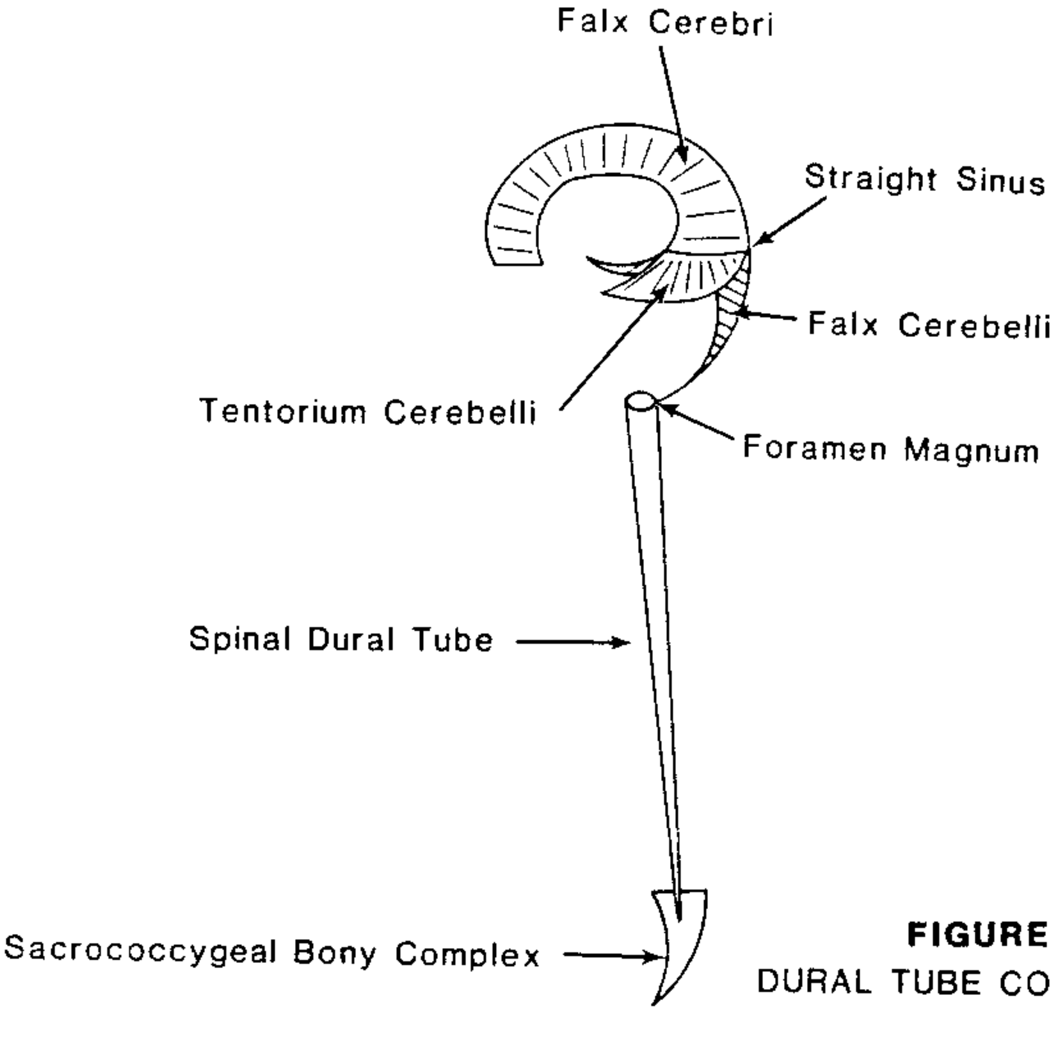


FIGURE 7
DURAL TUBE CONTINUITY

The continuity of the dural membrane within the cranial vault and the vertebral canal can reflect and transmit tensions in many directions. This is further illustrated in the cranium by observing the STRESS FIBERS OF THE DURA MATER. (Arbuckle, 1977) These white fibrous fibers of the dura mater are arranged in definite groupings:

1) horizontal groups
2) vertical groups
3) a transverse group
4) circular groups
5) spinal groups

Dr. Arbuckle's book <u>The Selected Writings of Beryl C. Arbuckle, D.O., F.A.C.O.P.</u> (1977) describes these fibrous patterns in detail. Even though individual groups of fibers can be described as having distinct origins and insertions, it must be emphasized that this fibrous network is a continuous system. (Figure 8)(Arbuckle, 1977)

FIGURE 8
STRESS FIBERS OF THE DURA MATER

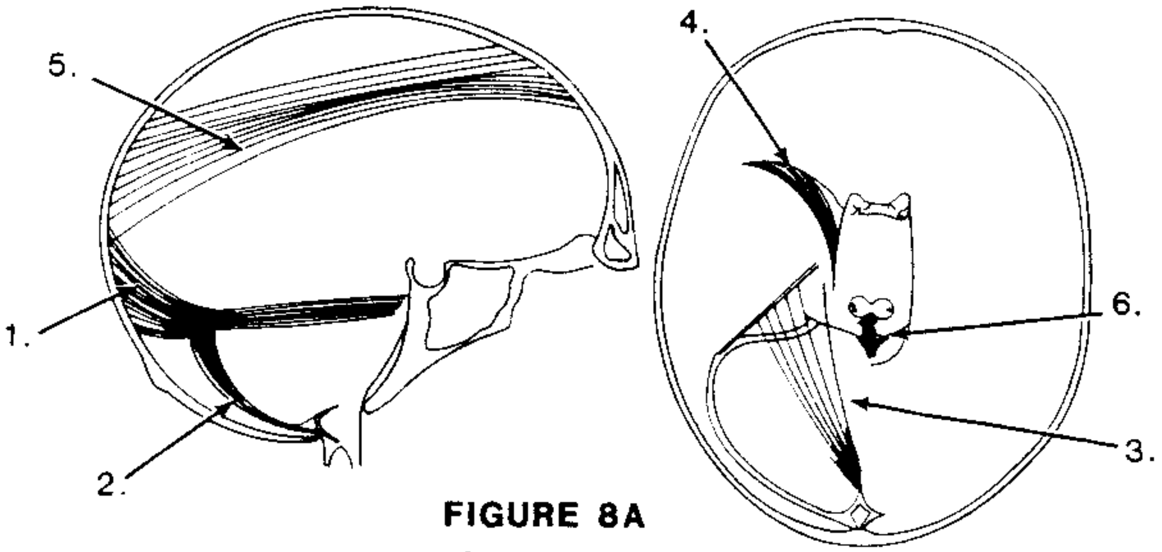


FIGURE 8A
HORIZONTAL

1. Falx Cerebri Inferior
2. Falx Cerebelli
3. Tentorium
4. Sphenoidal
5. Falx Cerebri Superior
6. Falx Cerebelli Tripod

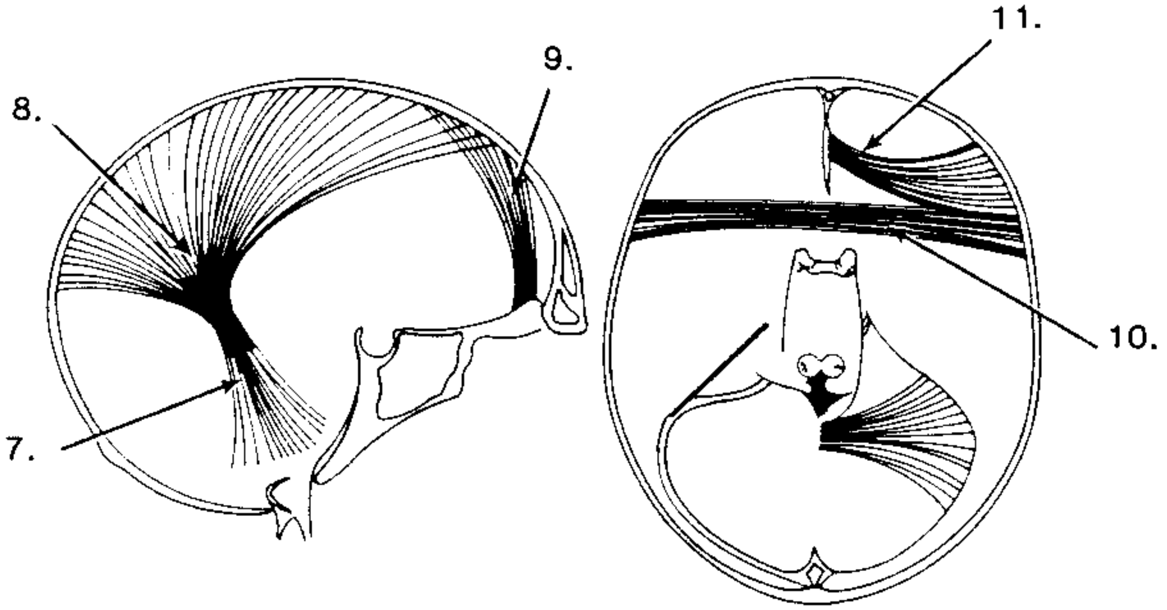


FIGURE 8B
VERTICAL & TRANSVERSE

7. Tentorium
8. Falx Cerebri Posterior
9. Falx Cerebri Anterior
10. Transverse
11. Crista Galli Tripod

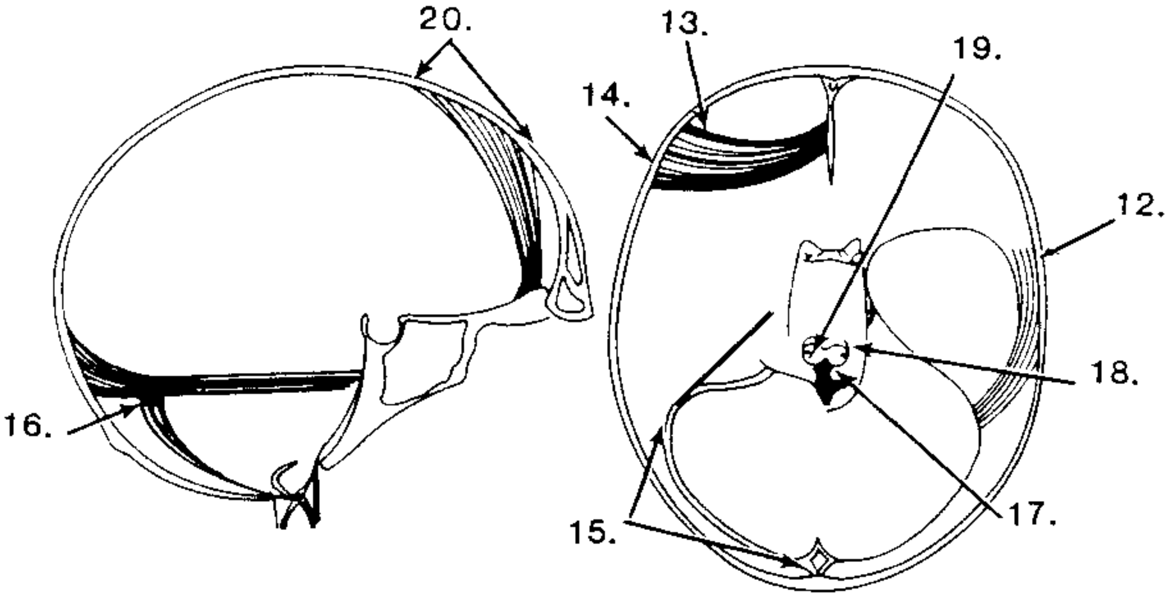


FIGURE 8C

CIRCULAR & SPINAL

12. Squamosal
13. Anterior Vault
14. Middle Vault
15. Posterior Vault
16. Posterior Fossa
17. Posterior--Tripod
18. Anterior--Tripod
19. Lateral Fibers
20. Metopic Area

Abnormal tension in a certain direction over a period of time will cause the fibers of the dural membrane system to malalign. Upledger has observed abnormal fibrous changes in the falx cerebri, tentorium cerebelli, and the falx cerebelli of human and primate cadavers. (1983)

Pressurestat Model

This mechanical **reciprocal tension membrane** system is only a partial representation of the craniosacral system. The dural membrane system houses the cerebrospinal fluid. It is the behavior of this fluid that completes an understanding of the craniosacral concept. Fluid enters the system via the choroid plexus which serves as a selective passageway for blood solutes from the vascular system into the ventricular system of the brain. The fluid within this system is known as the cerebrospinal fluid. The cerebrospinal fluid is returned to the venous system by the arachnoid villae which are mostly concentrated in the superior sagittal sinus but are also found throughout the cranial venous drainage system.

Semi-closed hydraulic system

The choroid plexus and arachnoid villae are under homeostatic control and serve as the regulatory mechanisms for the intake and outflow of this system. The shape of this hydraulic system is governed by fluid pressure within the dural membrane and by the cranial bones themselves which serve as anchors to which the membrane is firmly attached. The cranial bones are simply regarded as "hard places" in the dural membrane and are used as levers in treatment and as indicators in diagnosis. (Figure 9) (Upledger, 1983)

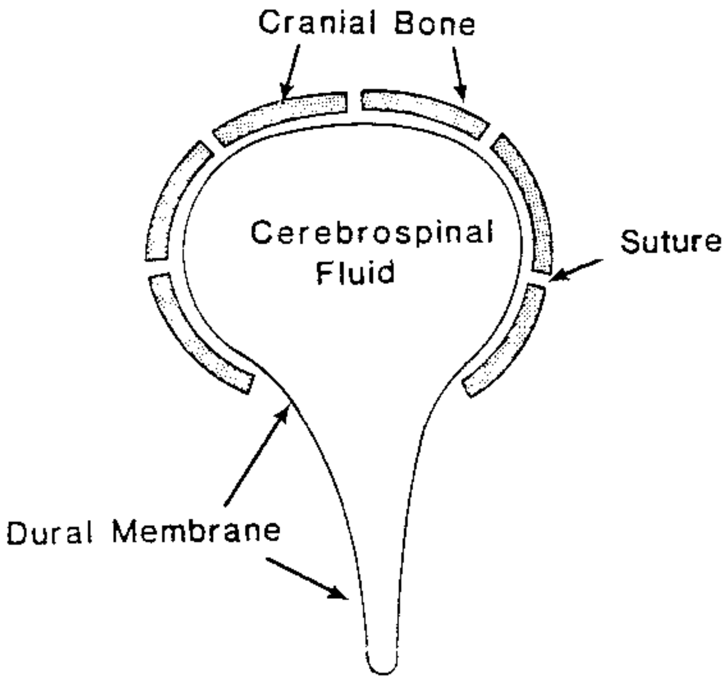


FIGURE 9

SEMI-CLOSED HYDRAULIC SYSTEM

Dr. John Upledger (1983) has proposed a pressurestat model that offers an explanation of cranial motility. In this model, the cerebrospinal fluid production by the choroid plexus is more rapid that the resorption of the cerebrospinal fluid by the arachnoid bodies. When an upper threshold is attained, a homeostatic mechanism would stop production of cerebrospinal fluid. When the intracranial pressure causes the suture to open to a specific dimension, a stretch reflex is activated that signals the ventricular system to stop production of cerebrospinal fluid. When the suture begins to compress, the intracranial cerebrospinal fluid pressure is reduced. The brain is then signaled to produce more cerebrospinal fluid. (Upledger, 1983)

This relay system has been histologically confirmed by Dr. Ernest Retzlaff. Dr. Retzlaff has traced single nerve axons extending from the sagittal suture through the meningeal membranes to the wall of the third ventricle. (Retzlaff, 1983)

Dr. Upledger thus conceives of a pressurestat mechanism acting upon the ventricular system of the brain. This pressurestat mechanism serves as the driving force of the inherent cranial motility of Dr. Sutherland's original conception of a primary respiratory mechanism.

Dr. Upledger's hypothesis is the most current in the field of cranial osteopathy. Dr. Harold Magoun (1976) has cited research that points to rhythmic contraction of the oligodendroglial cells of the neuroglia as a possible cause of motility and/or fluctuation in the cerebrospinal fluid system. Dr. Upledger does not accept the oligodendroglial cell movement theory as a possible explanation for inherent motility.

Craniosacral Motion

Craniosacral motion or cranial rhythmic impulse, inherent in the primary respiratory mechanism,

> **"occurs in man, other primates, canines, felines, and probably all or most other vertebrates."** (Upledger, 1983, p. 6)

This inherent motion is distinct from respiratory movements and cardiovascular activity. Since the craniosacral system is functionally related to the central nervous system, the autonomic nervous system, the endocrine system, and the neuromusculoskeletal system, the functional integrity of the craniosacral rhythmic impulse has a direct influence on the overall efficiency of these other systems. (Upledger, 1983)

The mechanical model and the pressurestat model serve to illustrate the primary respiratory mechanism. These two models also serve to illustrate the two-fold nature of the craniosacral motion:

1) the structural motion of the mechanical model, and
2) the fluid motion and its effect upon the central nervous system which is contained within the pressurestat model.

Structural Motion

There are two phases of structural motion in the reciprocal tension membrane system: flexion and extension. The rhythmic activity of flexion and extension appear

> **"at the sacrum as a gentle rocking motion about a transverse axis located approximately one inch anterior to the second sacral segment."** (Upledger, 1983, p.6)

In conjunction with the rocking motion at the sacrum, the transverse dimension of the head will broaden and narrow.

Cyclical flexion and extension occur at approximately six to twelve cycles pe minute; a neutral zone occurs as the body passes from flexion into extension. A cycle consists of flexion passing through neutral and entering into extension, thereupon returning to neutral and ending in flexion. One cycle normally takes about six seconds. (Upledger, 1983)

According to Dr. Sutherland's model, the **SPHENOBASILAR JOINT** is the central structure responsible for perpetrating cranial motility. The sphenobasilar joint connects the posterior portion of the sphenoid with the anterior portion of the occiput. (Figure 10) (Upledger, 1983)

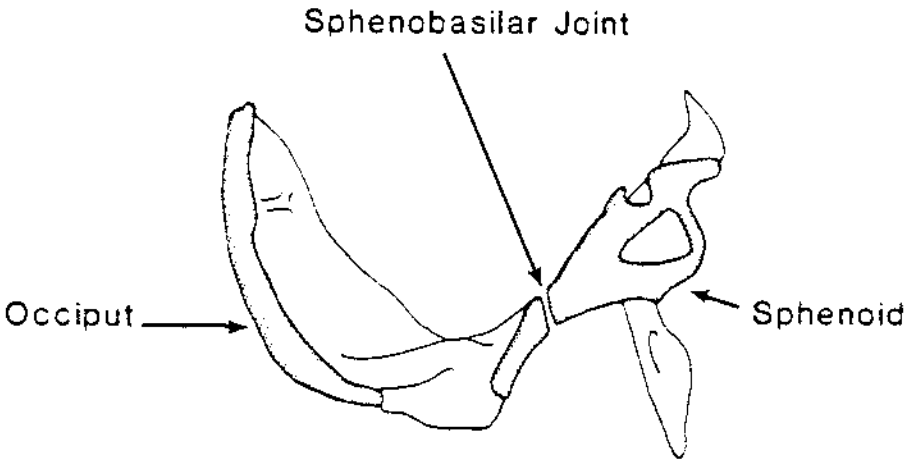


FIGURE 10
SPHENOBASILAR JOINT

This joint is the central part of a larger structure, the **CRANIAL BASE**. The cranial base includes the sphenoid, the petrous portion of the temporal bones, and the condylar portions of the occiput. (Figure 11) (Upledger, 1983)

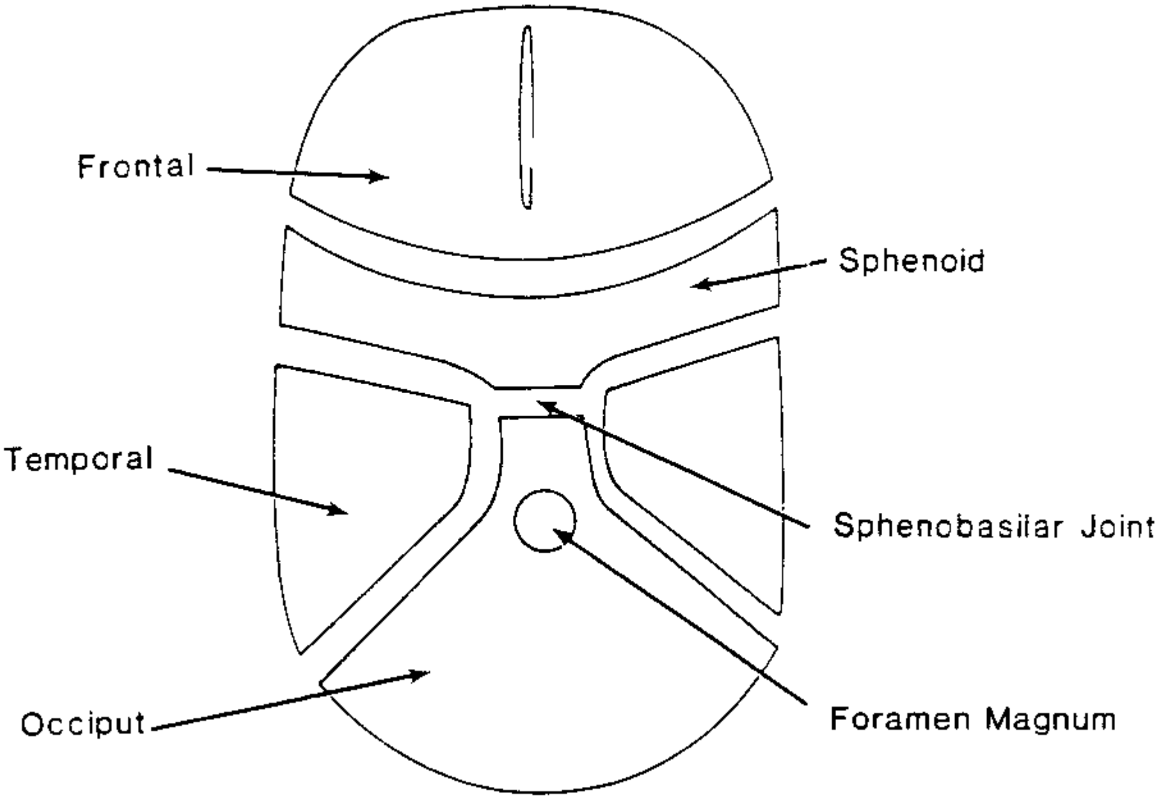


FIGURE 11
CRANIAL BASE

During flexion, the entire body broadens and the extremities rotate externally. There are four key points that clarify the concept of flexion:

1) The transverse dimension of the head widens as a results of the paired bones externally rotating. (Figure 12A)

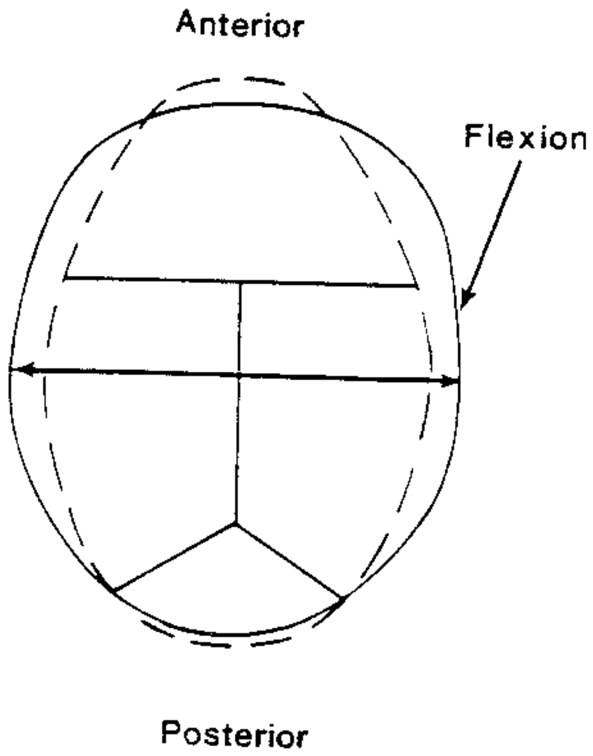
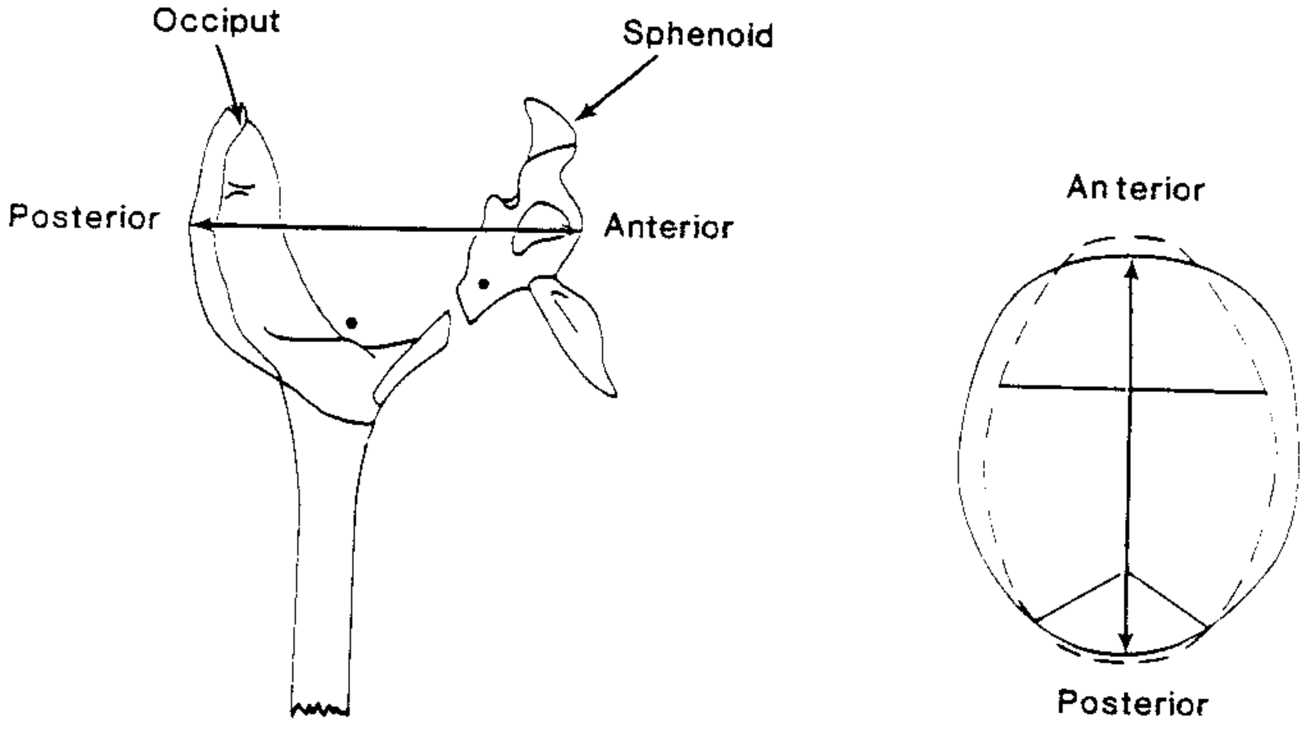


FIGURE 12A

2) The anteroposterior diameter of the skull decreases. (Figure 12B)



Saggital Plane

Coronal Plane

FIGURE 12B

3) The midline bones of the skull move into flexion around a transverse axis located in the sphenoid and the occiput. (Figure 12C)

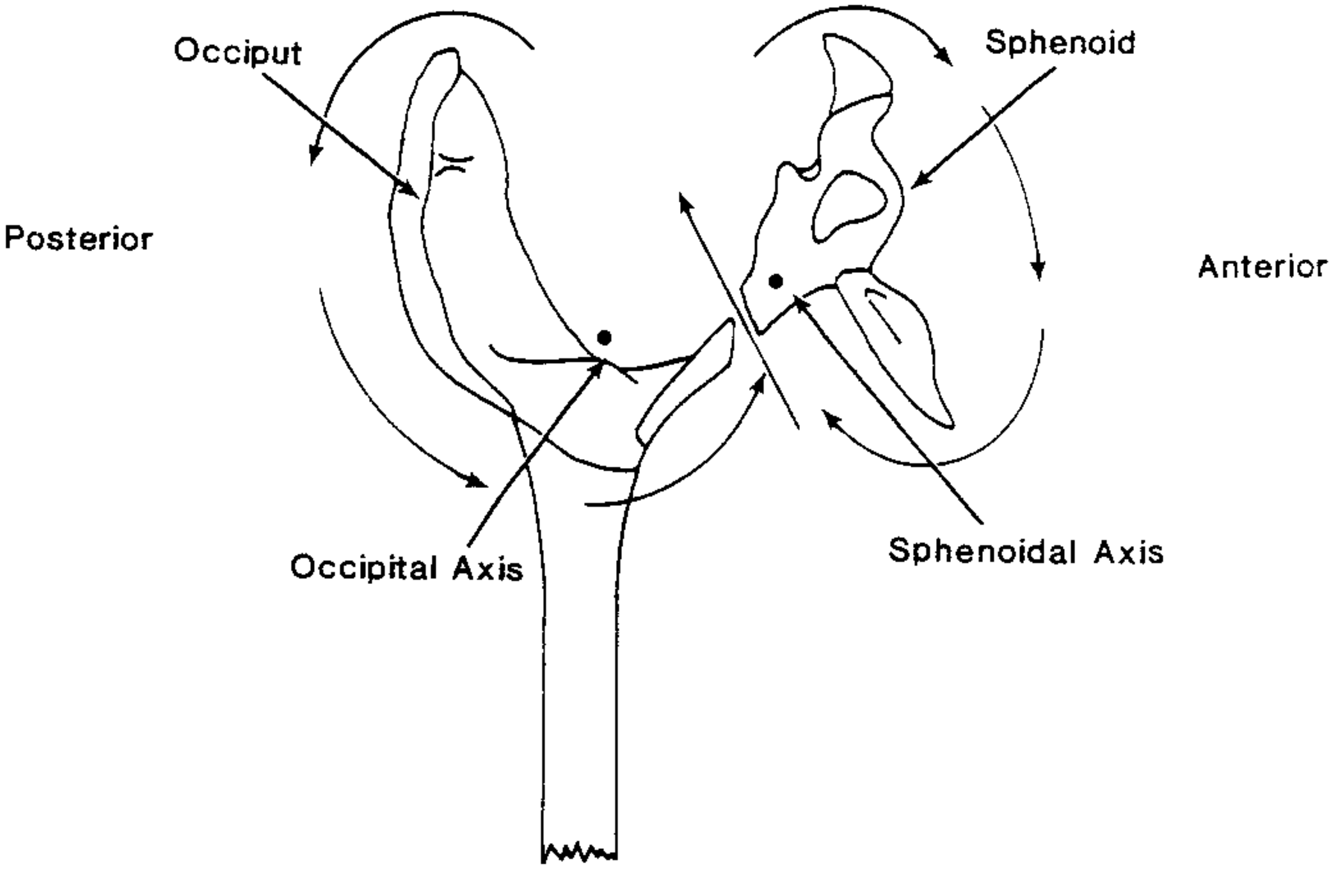


FIGURE 12C

4) The sacral apex moves in an anteroinferior direction and the sacral base moves in a posterior direction away from the symphysis pubis. There is a cephalad pull of the dura due to the elevation of the foramen magnum and the sphenobasilar joint. (Figure 12D)

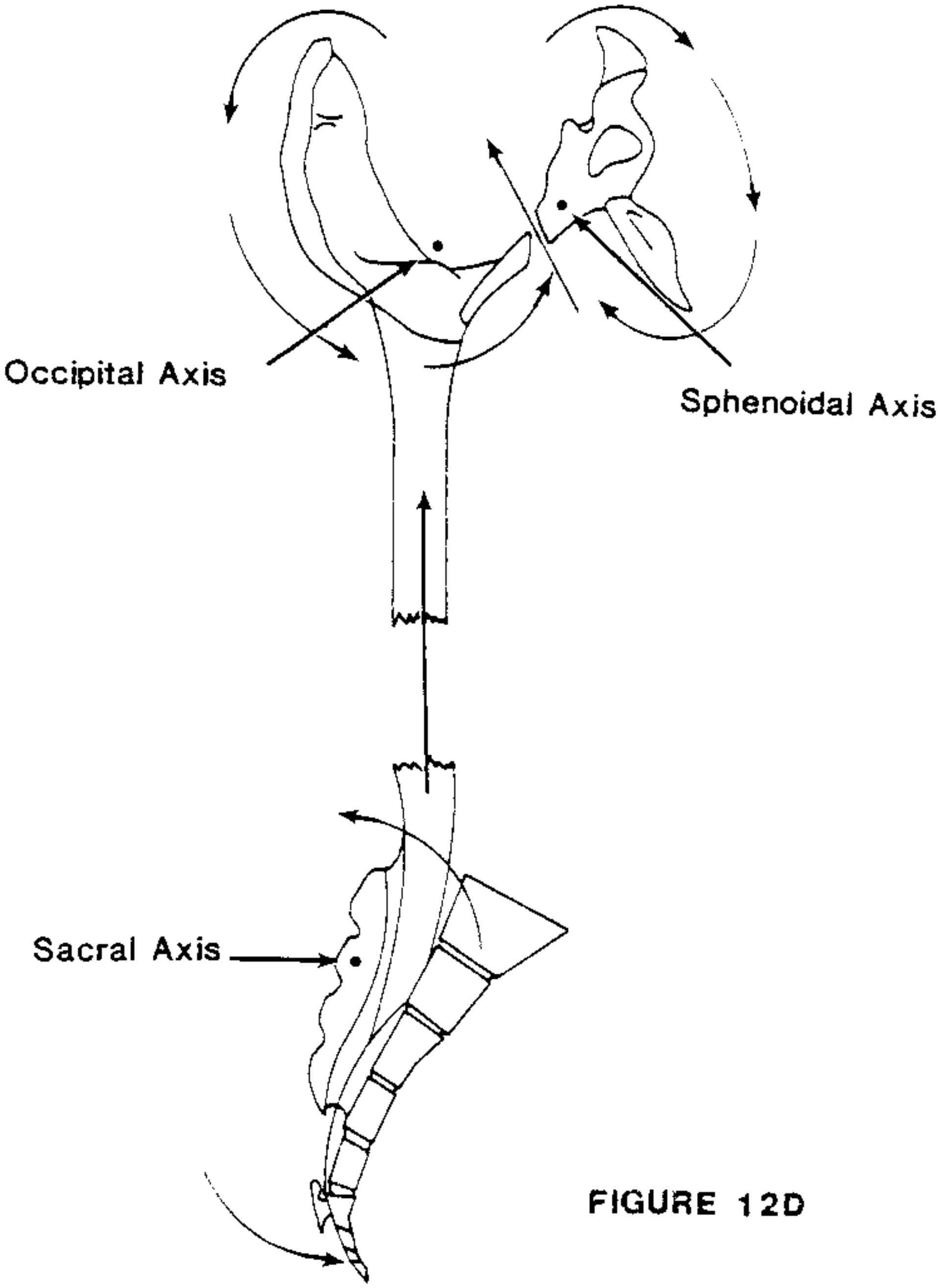


FIGURE 12D

During extension, the entire body narrows and the extremities rotate internally. The movements are the opposite of flexion and are illustrated in the following diagrams.

1) The transverse dimension of the head narrows as a result of the paired bones internally rotating. (Figure 13A)

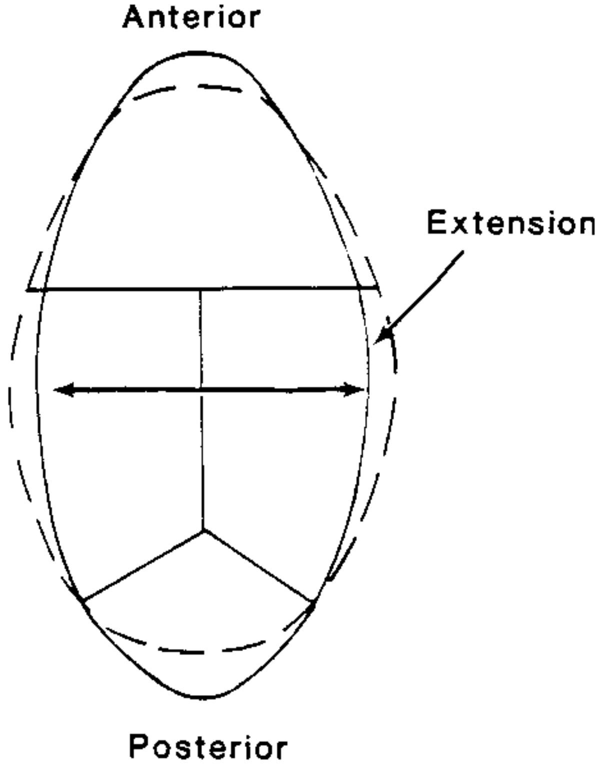
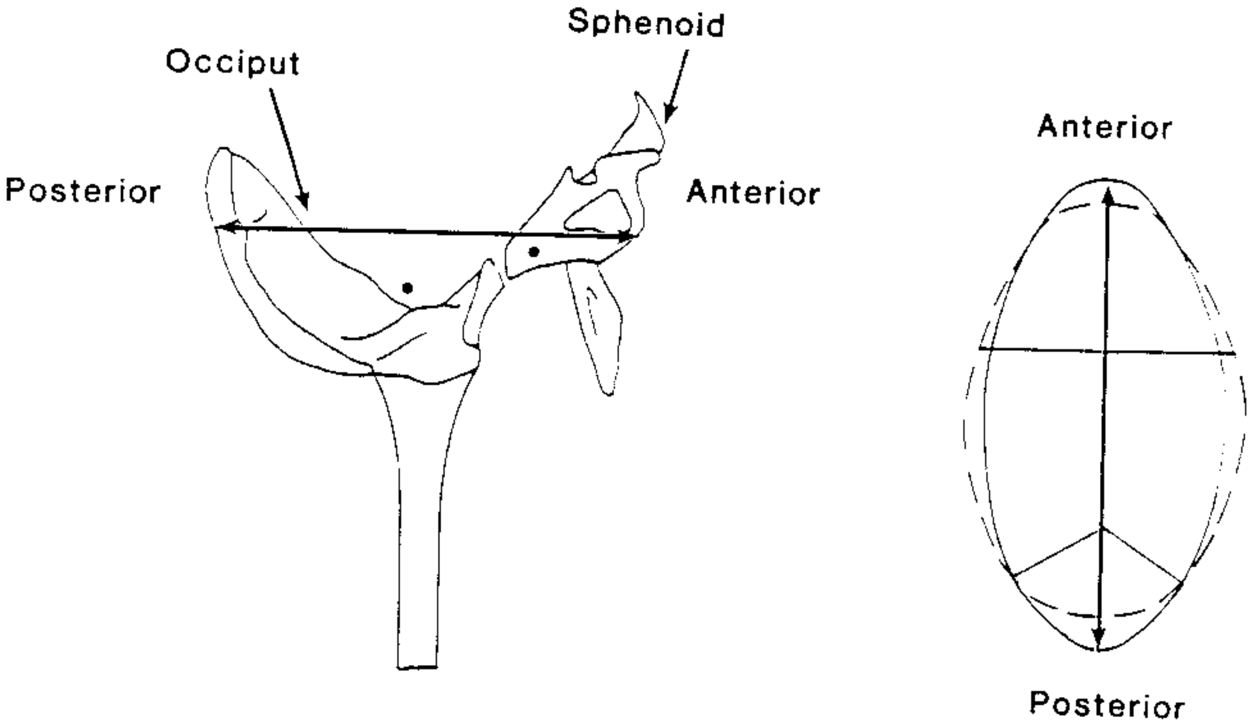


FIGURE 13A

2) The anteroposterior diameter of the skull increases. (Figure 13B)



Saggital Plane

Coronal Plane

FIGURE 13B

3) The midline bones of the skull move into extension around a transverse axis located in the sphenoid and the occiput. (Figure 13C)

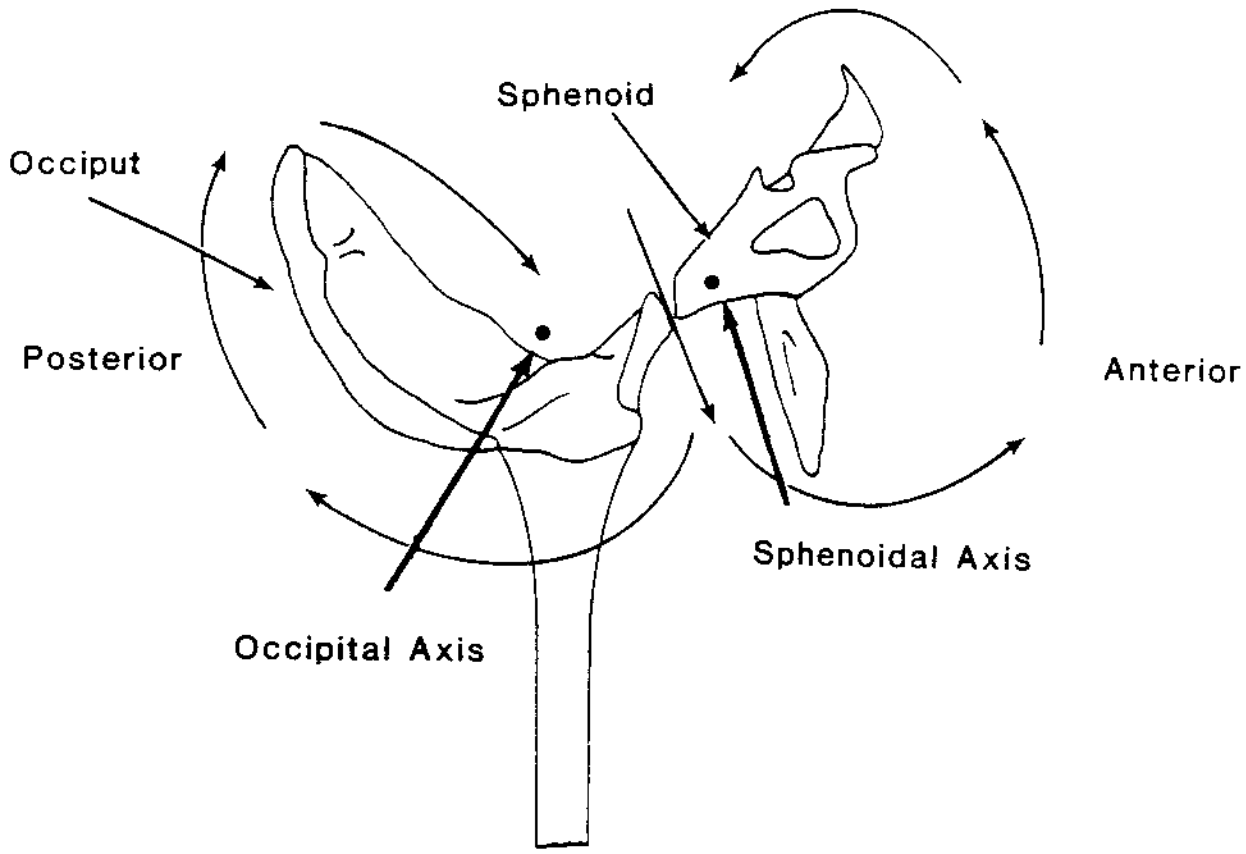


FIGURE 13C

4) The sacral apex moves in a posterosuperior direction and the sacral base moves in an anteroinferior direction towards the symphysis pubis. There is a caudal pull of the dura due to the lowering of the foramen magnum and the sphenobasilar joint. (Figure 13D)

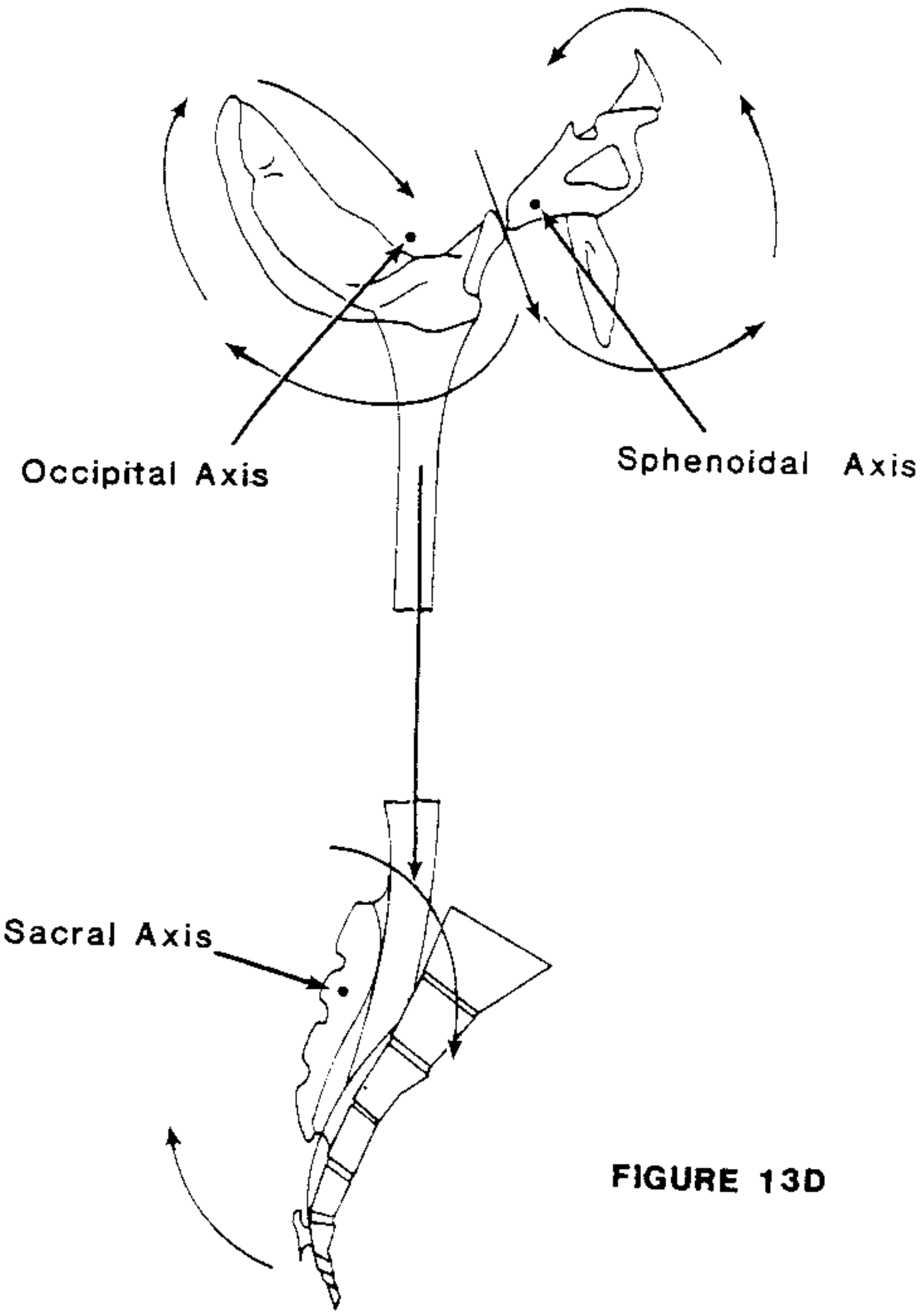


FIGURE 13D

Dr. Upledger notes that Dr. Sutherland's model incorrectly classified the sphenobasilar joint as a symphysis. Histologically, this joint is categorized as a synchondrosis.

This more recent observation by Dr. Upledger is clinically significant. Movements at a synchondrosis are more limited that at a symphysis. (Upledger, 1983) Dr. Sutherland emphasized the osseous nature of cranial base dysfunction evident at the sphenobasilar joint. Dr. Upledger proposes that distortions of the cranial base are the result of abnormal soft tissue or dural membrane tensions and/or sutural immobility rather than a dysfunction of the sphenobasilar joint itself. (Upledger, 1983) Thus, motion or lack of motion at the sphenobasilar synchondrosis is a manifestation of other restriction(s).

It becomes evident that craniosacral motion involves a flexion and an extension of the dural membrane found in the cranium and in the sacrum. The sphenobasilar joint is a central junction in the osseous structure and the straight sinus is a central junction in the membranous structure. The motion of the osseous and membranous structures is reflected in the positioning of the sacral base and sacral apex; and, this sacral positioning is similarly reflected in the motion of the osseous and membranous structures in the cranium. This totality of motion is made possible through dural tube continuity.

Fluid Motion

> "**All life is manifested in energy or motion.**" (Magoun, 1951, p.15)

The fluid motion of the brain and the central nervous system is graphically illustrated by Sutherland's analogy with a bird in flight. The central canal of the spinal cord and the fourth ventricle resemble the tail of the bird. The lateral ventricles resemble the wings. As the bird flies, the wings move in and out, anteriorly the posteriorly

During inhalation, the third ventricle dilates in a V-shaped manner and the floor of the ventricle moves upward. Attached to the floor of the third ventricle is the infundibulum which connects to the pituitary body in the sella turcica. The infundibulum draws the pituitary body upward at the posterior end of the sphenoid while the anterior portion of the sphenoid moves downward. The cerebrospinal fluid fluctuates through the ventricular system during inhalation causing a dilation or expansion of the ventricles.

During exhalation, the ventricles contract and the fluid fluctuates in the opposite direction. This contraction is analogous to the folding of the bird's wings. (Sutherland, 1967) As the ventricles increase in size during inhalation (flexion), there is a simultaneous increase in the subarachnoid space. The capacity for a greater volume of cerebrospinal fluid is thus increased. The choroid plexuses open out as the ventricles expand and the production of cerebrospinal fluid is increased. (Upledger, 1983)

The osseous nature of the sphenobasilar joint emphasized by Dr. Sutherland is thus contained within a fluid motion of the primary respiratory mechanism. According to Dr.

Upledger's hypothesis, the sphenobasilar joint is an integral part of that fluid motion but is not the primary cause.

Dr. Magoun (1976) points out that Sutherland's conclusions were based on the

> "**cerebrospinal fluid physiology in its own natural environment.**" (p.25)

This fluctuation of the cerebrospinal fluid has a physical potency acting as a hydrodynamic mechanism and an electrical potential with positive and negative phases. The electrical potential is directly related to tissue chemistry. The osteopathic approach to disease acknowledges this primary importance of the physical and chemical integrity of body tissues. (Magoun, 1976)

The decade since the publication of Magoun's third edition of Osteopathy in the Cranial Field has been one of unparalleled discovery in the interdependence of chemical and electrical properties of the brain. R.T. Lustwig wrote:

> "'**Sutherland's work . . . puts him on record as having recognized at an early date the interchangeability of energy as it relates to biology . . .** '" (Magoun, 1976, p. 26)

Fascial Continuity

Dr. Upledger emphasizes a concept that is helpful in understanding the comprehensive nature of craniosacral application — fascial continuity. Fascia is a connective tissue composed primarily of collagenous and elastic fibers. Dr. Upledger proposes and **elastocollagenous complex** to serve as the contractile mechanism of fascial tissue.

In this model, the elastic fibers are the core. The fascial tissue is regarded as the unifying structure of the body. Fascia is continuous from head to toe. Viscera, muscles, and skeletal structures are present among this continuous network. The central nervous system and the vertebral column are viewed as tubes within this continuous structure.

> "**One may regard the fascial organ as a maze which allows travel from any one place in the body to any other place without ever leaving fascia.**" (Upledger, 1983, p.239)

Fascia is mobile. Dysfunction or injury reduces this fascial mobility which is then manifested as an abnormal alteration in the physiological motion of the craniosacral system. (Upledger, 1983) This simplistic reduction of a complex system allows one to comprehend the totality of craniosacral application to the body as a unified whole.

Research in craniosacral mechanisms has been approached from two areas of experimentation:

1) Physiological experiments have provided information about the changes in skull volumes as a result of cranial mobility.

2) Histological studies have provided information about the sutural structure that would permit cranial mobility.

A survey of these research efforts follows.

Physiological experiments

The existence of a rhythmic motion slower than thoracic respiration and the vascular pulse has been detected for more than thirty years by those trained in palpation. Dr. Viola Frymann (1971) conducted a series of experiments designed to investigate the motion of the living cranium. An apparatus was constructed to measure this motion and is described in Frymann's paper "A Study of the Rhythmic Motions of the Living Cranium."

More recently, (1983) an instrument similar to Dr. Frymann's was constructed at the West Virginia School of Osteopathic Medicine to be used in the evaluation of cranial rhythm in both animals and humans.

Dr. Frymann observed a rhythm synchronous with respiration and cardiac activity and another slower wave motion independent of the other two. In this article, Dr. Frymann compares this inherent physiologic motion with other known physiologic phenomena as recorded by Ruch and Fulton, Sears, and Moskalenklo and Naumenko.

Ruch and Fulton observed inherent automaticity in the neuronal activity of the vasomotor center; waves of changing pressure slower and longer than those associated with both cardiac and respiratory rate:

> **"The rhythm of the impulse groups . . . not infrequently . . . bears no relationship to any other observable cyclic phenomenon in the body."** (Frymann quoting Ruch, p.94)

The waxing and waning of arterial pressure elicit rhythmic changes in the activity of the vasomotor center. These changing pressure waves are usually termed Traube Herring phenomena.

Sears postulated these longer waves originate in the respiratory center of the medulla through spinal respiratory motor neurons. Isolated central respiratory drive potentials (CRDP'S) were observed in his study and Dr. Frymann notes the similarities of these potentials to some of the cranial recordings in her present study.

Moskalenklo and Naumenko, investigating the existence of cerebral pulsation in a closed cranial cavity, demonstrated cerebrospinal fluid movement by electroplethysmography. This continual movement between the subarachnoid spaces and the spinal cord was represented in the form of displacements occurring with cardiac activity, respiration, and third order was defined as Traube Herring waves. Dr. Frymann concludes:

> "**. . . the vasomotor center and the respiratory center on the floor of the fourth ventricle possess a functional activity which at times manifests a rhythmic periodicity similar to but slower than that of respiration.**" (Frymann, 1971)

In 1975, another team researchers focused on the squirrel monkey. Retzlaff, Michael, and Roppel (1975) performed experiments on anesthetized female squirrel monkeys using a stereotaxic instrument to measure parietal bone movement. When the monkey's head is allowed free movement in the head holder, the pattern of movement is directly related to cardiac and respiratory activity. This is a slow wave with each respiratory cycle and a rapid, oscillatory wave superimposed reflecting cardiac activity.

With limited movement in the head holder, the free movement of cranial bones begins to appear; whereas right parietal bone movement almost matches respiratory activity, the left parietal bone moves independently. Fast oscillatory waves are double that of cardiac activity.

Complete immobilization of the head results in two independent motions. The parietal bones have their own slow wave frequency and the fast wave pattern is different than cardiac activity.

By flexing and extending the monkey's body, an increased amplitude of both slow and fast waves can be induced.

> "**The one to one ratio of vertebral column movement and the parietal bone movement indicated that alterations in cerebrospinal fluid are responsible for bone movement.**" (Retzlaff, 1975, p.872/145)

Thus, Dr. Retzlaff's study establishes that the movement of parietal bones does exist and proposes that this slow spontaneous movement is a direct result of cerebrospinal fluid pressure changes.

Greenman (1970) correlates roentgen findings of the skull with clinical evaluation and provides x-ray appearance of altered cranial structure. Cranial abnormalities of flexion, extension, torsion, and side-bending can be demonstrated roentgenographically and correlate well with independent clinical evaluation. Greenman's study has two illustrative cases that provide evidence that altered structural findings are indeed indicative of impaired function. (Greenman, 1970)

Histological Research

The structure of the cranial bone suture has received much study by those interested in the mechanisms of craniosacral therapy. The suture is a logical object of investigation since it is the way in which cranial bones are joined together while permitting slight motion. Pritchard, Scott, and Girgis (1956) produced one of the most informative studies of the development of mammalian cranial sutures. The decade of the 1970's saw Dr. Ernest Retzlaff and others leading the way in extending current knowledge of adult cranial suture structure through investigations on the squirrel monkey. The results of these studies provide an anatomical basis for understanding cranial suture mobility.

Upledger and Vredevoogd have prepared a color slide set of the intracranial membrane system. This slide set includes the intact intracranial membrane system photographed from human dissections as well as the gross anatomy, the histo-anatomy and the micro-anatomy of the human cranial sutures. (1983)

Cranial bones are joined together by a connective tissue bridge called a suture. There are three connective tissue types found in the suture: collagenous, reticular, and elastic. An inner and outer periosteum house this connective tissue matrix which in turn possesses the cellular elements involved in bone deposition and resorption. (Retzlaff, 1984)

Pritchard et al. (1956) investigated the development and structure of sutures in the rat, sheep, pig, cat, rabbit, and man. They found five intervening layers of cells and fibers between cranial articulations and two uniting layers of fibrous strata joining the inner and outer boundaries of the suture. This study infers that sutures allow for expansion during bone growth and form a strong bond between articular surfaces that allows for slight movement.

Retzlaff, Michael, Roppel, and Mitchell (1976) confirmed the five layers of cells. Their study utilized adult squirrel monkeys, all ten of which showed:

> **"no evidence of sutural ossification."**(Retzlaff p. 607/106)

Four articular patterns are observed between parietal bones and adjacent cranial bones:

1) The plane suture
2) the squamous suture
3) the serrate suture
4) the denticulate suture

Retzlaff suggests that the plane and squamous suture have a sliding and a separating movement while the serrate and the denticulate articulations permit a hinge type movement. (Retzlaff, 1984)

Collagen fibers are the most abundant connective tissue present in the suture. Bundles of collagen fiber (Sharpey's fibers) penetrate the cranial bone and extend across the suture connecting one bone with the opposite bone. An arteriole and one or more nonmyelinated nerve fiber(s) accompany each Sharpey's fiber upon penetration of the cranial bone. The nerve fiber and arteriole enter the Haversian canal system and extend into the myeloid spaces. Sharpey's fibers are most numerous in areas where bones are subjected to the greatest separation forces. Thus, Sharpey's fiber bundles serve functionally as anchors for cranial bones allowing firm but movable attachments between bones. (Retzlaff, 1982)

A reticular type of connective tissue is seen in conjunction with the collagen bundles. They also penetrate the cranial bone and may serve as anchors for the Sharpey's fiber bundles in the bone. Elastic tissue is observed to criss-cross the collagen bundles perhaps serving as a contractile mechanism. (Retzlaff, 1984)

The sutural matrix is highly vascularized and possesses nerve fibers. Retzlaff hypothesizes that an autonomic nervous system reflex is mediated by these nerve fibers. This reflex is part vasomotor and part sensory in function. (Retzlaff, 1982-83)

Two fiber types appear to be related to the sutural vasculature:

1) one type possesses enlargements which are synaptic vesicles and run parallel to the arterial vessels;

2) the other type, found in relation to the walls of venous vessels and the superior sagittal sinus, are small branched nerve fibers, possibly functioning as sensory receptors in the veins.

Nerve fibers also accompany the reticular connective tissue and go beyond the tissue to enter the Haversian system.

Nonmyelinated autonomic fibers, innervating the arterioles in the dura and sutures, are thought

> "**to be neurosecretory in function and control vascular constriction.**" (Retzlaff, 1984, p. 115)

Free-ending fiber types are found in all of the major vessels in the dura, in the suture, and in the walls of the third ventricle of the brain. Dr. Retzlaff and others suggest that these free endings

> "**represent the origin of the dendrites which are involved in sensation from the sutures to the dura and the walls of the third ventricle.**" (Retzlaff, 1984, p. 116)

Anatomical abnormalities, evidenced by sutural compression, result in pathology — physical and/or emotional in nature.

> **"It seem certain that craniosacral lesions result in a compression of the vasculature and the nerve fibers and their endings in sutures."** (Retzlaff et al. , 1983-83, p. 10)

This compression results in tissue ischemia; and in turn, ischemic conditions lead to localized as well as referred pain.

Dr. Retzlaff proposes pain perception may be functionally related to the venous vasculature. He points out that there is a lack of studies on the innervation of venous blood vessels and hypothesizes that the free-ending type receptors located in the connective tissue sheath surrounding veins could be one mechanism of referred pain from cranial sutures. These would in fact be stimulated by ischemia conditions.

Dr. Retzlaff further suggests that this vascular compression and resulting ischemia could interfere with the production and action of the endorphin system. This malfunction of the endorphin system would have a direct result in pain perception. Through sutural decompression, blood supply can be restored, thereby reducing ischemia and consequent effects on nerve fibers, blood flow, and the endorphin system. (Retzlaff, 1984) Sutural decompression is achieved through craniosacral manipulative techniques which restore normal cranial mobility.

> **"The effectiveness of craniosacral manipulative therapy may be due to decompression of the suture which would allow the blood supply to be restored to the area . . . (and) the endorphins to become effective in the area that had suffered ischemia."** (Retzlaff, 1984, p.117-118)

Dr. Retzlaff not only identifies pain as a direct result of sutural compression but also notes that a direct result of such compression could be

> **"a disturbance in function of the areas of the brain which are supplied by the sutural blood vessels and nerve fibers."** (Retzlaff, 1982-83, p. 10)

Furthermore, **nerve fibers having unknown destinations** may be involved in central nervous system functioning and be related to behavioral and/or emotional problems. (Retzlaff, 1982-83)

The cranial perspective views the functioning body as physiologic motion. Restriction of that motion results in pathology. Clinical application of craniosacral techniques dares to improve upon existing structure and function. Is this altered structure **the end result** of abnormal cranial bone movement? Or is altered structure **the cause** of abnormal cranial bone movement? Regardless of which comes first, clinical application of cranial technique attempts to restore proper movement which in turn elicits improved pathology.

Investigative Studies

Four investigative studies serve to illustrate statistical clinical findings of restricted cranial motion and pathology.

1) Severe craniosacral restrictions were observed in twenty-five children aged 5-18 at Genesse Intermediate School District's Center for Autism in Flint, Michigan. (Upledger, 1983)

2) In a study by Dr. Viola Frymann (1966) , 1250 newborn infants were examined for restricted craniosacral motion. Less than twelve per cent were found to have freely mobile craniosacral mechanisms. Strain patterns within the developmental parts of the occiput produced nervous symptoms (16.88) while a torsion strain at the sphenobasilar symphysis and temporal restrictions produced respiratory and circulatory problems (12. 5%)

3) Dr. Upledger (1978) found a positive correlation of restricted craniosacral motion and children with developmental problems. These 203 children were labeled *not normal, learning disabled, behavioral problems,* or *motor problems.* There was found to be a positive relationship between complicated obstetrical delivery and restricted craniosacral motion. Children with multiple problems provided the most positive correlation with craniosacral motion restriction scores.

4) A study by Woods and Woods (1961) revealed a rate of cranial impulse in sixty-two normal individuals at the rate of 12.47 per minute whereas 102 psychiatric patients exhibited an average rate of 6.7 per minute. The most disturbed patients exhibited the lowest rates.

Overview

The scope of clinical application is almost endless;

> "**. . . no system of treatment involves a wider potential of influence** . . ." (Magoun, 1976, p. 106)

In his book, Osteopathy in the Cranial Field (1951), Dr. Harold Magoun gives a synopsis of the scope of the non-invasive, non-drug approach to pathology. The following excerpt is found in this 1951 edition of Dr. Magoun's book and serves to underscore the potential of cranial osteopathy.

> **Under its sway may come any of the motor or sensory functions of the cerebral cortex such as thermal, tactile, proprioceptive, visual, auditory, olfactory, and gustatory; any of the hypothalamic manifestations including emotion, sleep, temperature, fat metabolism and the major role played by the pituitary in its oxytocic, pressor or "master gland" phases; syndromes referable to the brain stem where are located practically all of the cranial nerve nuclei as well as the cardiac and respiratory centers, giving rise to such symptoms as nausea, vomiting, diarrhea, constipation, cardiac irregularities, asthma, ocular imbalance, vertigo, head noises, ataxia, etc.; cerebellar pathologies in motor coordination evidenced by ataxia, tremor, muscle nerve dystrophies explaining loss of smell, visual disturbances, trigeminal neuralgia, deafness, vertigo, vagal syndromes involving the gastrointestinal and respiratory and cardiac parasympathetic distribution; degenerative diseases of "unknown etiology" such as multiple sclerosis, amyotrophic lateral sclerosis, progressive muscular atrophy, syringomyelia, muscular dystrophy and the like.**
>
> **Special mention should be made of cranial birth injuries with the resulting muscle tremor, disturbances in swallowing, vomiting, abnormal crying, respiratory difficulties and obvious skull distortion or the head trauma in later life manifested by pain, vertigo, dysfunction etc.**
>
> **The work should be of special interest to physicians in the fields of nervous and mental disease, pediatrics, or eye, ear, nose and throat. In the latter, new light is thrown on such conditions as sinusitis, colds, myopia, hyperopia, astigmatism, strabismus, nystagmus, conjunctivitis, involvement of the sphenopalatine ganglion and its distribution, bent septa and other "surgical" conditions, pharyngeal pathology and the like.**
>
> **If for no other reason than the relief offered the average case of tic douloureux or migraine, Dr. Sutherland's concept would justify its existence.**
>
> **And this survey by no means covers the entire field. Perhaps it might best be summarized by saying that *Cranial Osteopathy definitely reduces the idiopathic field of disease etiology and emphatically strengthens the therapeutic approach to nervous, vascular, and physiological phenomena resulting from local***

> ***pathology involving the central nervous system.* (italics added)** (Magoun, 1951, p. xii-xiii)

The 1976 edition of the same book, Osteopathy in the Cranial Field, lists diagnosis with case history, thereby providing a more specific application of craniosacral therapy.

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1) Dyslexia has been successfully treated with mobilization of the temporal bones and occipitomastoid sutures.

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3) Reactive and endogenous depressions have consistently exhibited anteroposterior compression of the cranial base.

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This recent publication presents a thorough compilation of the clinical significance of craniosacral therapy.

Synopsis

Dr. Andrew Taylor Still's philosophical wisdom is appropriate for this decade:

> **"Previous to all discovery there exists the demand for the discovery."** (Truhlar quoting Still, 1950, p. 34)

Osteopathic medicine in the cranial field gives us a discovery — the discovery of a physiological mechanism that is amenable to correction and that does influence the overall functioning of the body. It gives us a treatment modality that

> **"employs internal agents to deal with internal pathologies." (Magoun, 1951, p. xiii)**

The demand for discovery in the face of epidemic tragedy let Dr. Andrew Taylor Still to devise a method and philosophy of medicine called Osteopathy. The demand for discovery led William Garner Sutherland to question the design of the skull. And, today, the demand for discovery is stimulating researchers like Dr. Ernest Retzlaff and Dr. John Upledger to investigate the mechanisms governing the craniosacral system.

Osteopathy in the cranial field is providing answers to complex pathologies. Perhaps the rapid growth in the neurosciences coupled with osteopathic research in craniosacral mechanisms will discover a neurobiological basis for the results obtained in clinical practice.

The study of the body and its inherent abilities of self-regulation should be the top priority of medicine. Osteopathy in the cranial field is re-emphasizing this fundamental truth that appears to have been overlooked.

> **"To find health should be the object of the doctor. Anyone can find disease."**
> Andrew Taylor Still

The author of this presentation has been a chronic pain patient for ten years: trigeminal nerve/temporomandibular joint pain with intracranial pressure coupled with low back pain and sciatica, unresolved by laminectomy and spinal fusion.

Diagnostic labels were applied:

degenerative disc disease
TMJ dysfunction
reactive depression
trigeminal facial neuralgia
paroxysmal kinesogenic choreoathetosis
congenital collagen tissue disorder

Symptomatology was complex:

low back pain and sciatica
temporomandibular joint pain
facial neuralgia
abnormal facial movement and muscle spasm
sinusitis
intracranial pressure
convulsions
dystonic posturing
depression
low blood sugar
vertigo

Many routes were tried using modalities such as :

physiotherapy
biofeedback
acupuncture
chiropractic manipulation
meditation
self-hypnosis
autogenic relaxation
imagery
drugs
TENS unit
TMJ splint therapy
dental equilibration
back surgery
sinus surgery
psychological/psychiatric intervention

When a third exploratory back surgery was recommended, there were more questions than answers.

The search for answers lasted five years as all of the preceding modalities were hopefully explored. **The answery** — craniosacral therapy — has taken another five years. The structural alignment coupled with somato-emotional release has **resolved 95% of the pain and anxiety**.

The treatment of the body as a physiological totality allows for successful elimination of patterns of maladaptive reactivity. These patterns of expression can be physical and/or emotional and represent the total effort of a body to function.

Illness manifests itself when the natural vitality of the body is suppressed due to disease, trauma, or emotional conflict. A system of medicine that can stimulate inherent physiological resources can thus increase the total efficiency of the whole person.

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