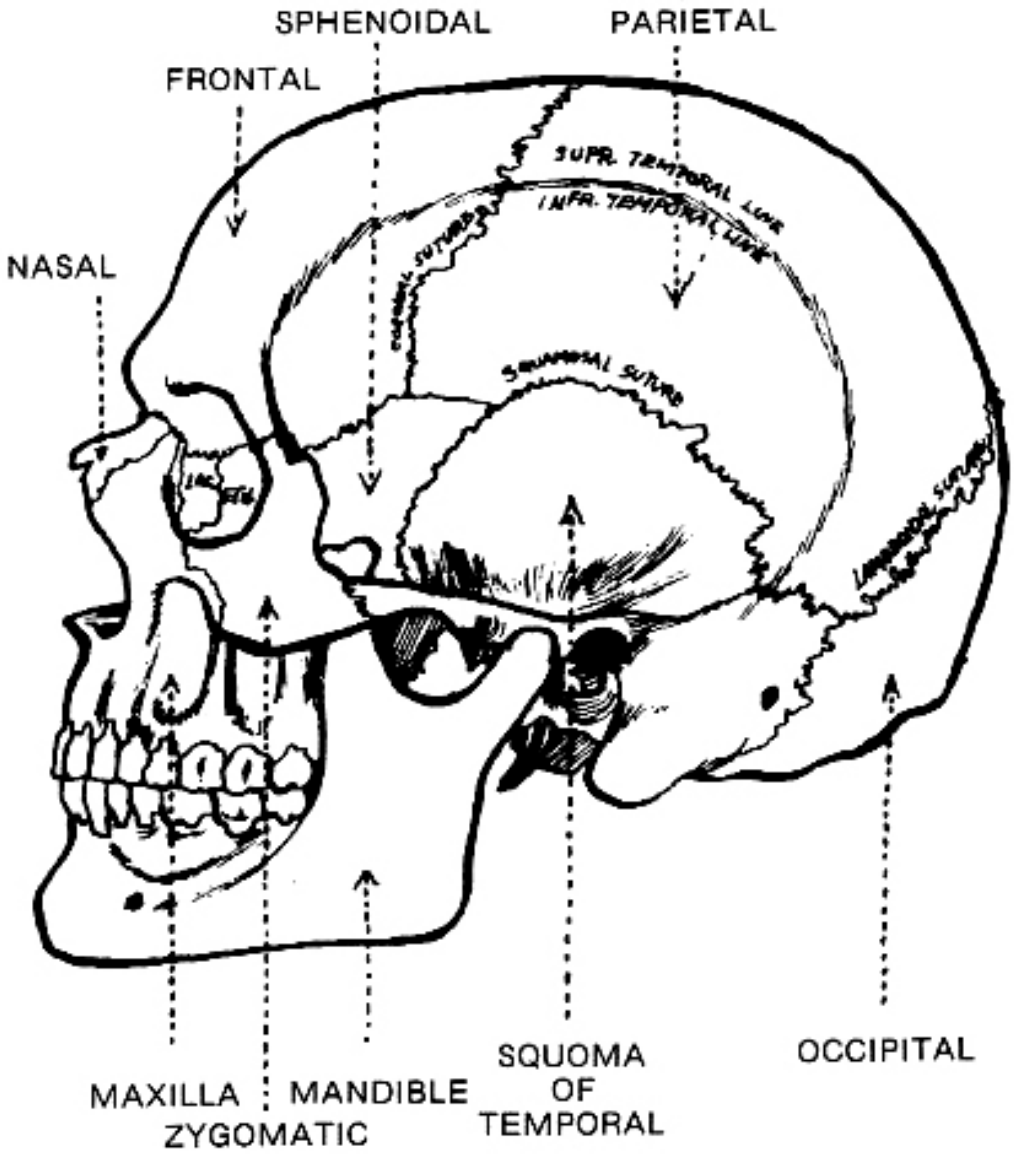
SUTURES AND BONES OF THE SKULL



The Cranium

by Isabell Biddle, D.O.

In keeping with her feeling that "every one of these bones should be studied by a person doing manipulative work for their *movement* in connection with the spine and the sacrum," Dr. Biddle has provided us with the third article in her series on *the anatomy of use.*

The outermost covering or protector of the brain is the cranium which includes its bony structure, scalp, and hair. This bony fortification and bulwark of the cranium protects and limits the brain's motion, for being a living structure, it expands and contracts in the same manner as does any other living cell or organ. The cranium is lined by the dura mater and that lining is called the pericranium; it receives the sinuses including the longitudinal sinus; it collects and smooths the processes of the dura mater and, in embryonic life adheres as a kindred substance to the brain itself and makes common cause with it.

Contained in this bony structure are the cerebrum, cerebellum, and medulla oblongata as well as the other structures of the brain which supply its anabolic and catabolic needs.

In shape the cranium is oval, yet irregularly so; convex and smooth externally, concave and rough internally. Its size and thickness are irregular and its substance, especially during the first year of life, is predominately cartilaginous, becoming more bony as the child develops into adult life. Then the single structure of the bones develops two tables or plates, external and internal with an intermediate diploe or central structure more like air cells intervening. This gives the cranium its sound-board capacity through its connection with the sinuses.

The skull, (see illustration) is composed, from the front backward, of two frontal bones in infancy, (which bones fuse as a rule into one later as the head and brain develop); two temporal bones, one on either side connecting the parietal, occipital, sphenoid, frontal and malar, (the temporals carry the ear and its sensory structure); two parietal bones which form the vault of the head; the occipital bone by which it is attached to the spine and to the sphenoid which articulates with it and connects with all the

other bones by articulatory contact. These all articulate with the facial bones, the zygoma, frontal, nasal and malar and form an important external meeting place, where the spine of the ethmoid comes up into the cranial cavity and forms the attachment of the dura to it and the adjacent parts of the frontal.

The temporal bones form the sides of the skull connecting with the occiput, parietal, frontal, sphenoid, malar and mandibles, indirectly helping to form the orbit.

The facial bones consist of upper jaw or malar bones, to which are attached the zygoma or cheek bones and the lower jaw or mandibular for the lower teeth. All these bones have movable articulations and work in unison with respiration.

Then there are small interior cartilaginous bony structures, as the nasal septum, turbinated bones that roll on respiration; the palatine which forms the posterior arch of the mouth; the vomer which forms the split by which the septum of the nose is set in and part of the mouth; the small bones of the ear to receive and distribute the air currents.

The sphenoid bone connects all structures and is one of the most interestingly-constructed instruments in our body for it helps in the formation and continuity of the air cells of the face and head. If out of alignment, it causes a great many head symptoms, sinus conditions, and so on. The sphenoid is often merely mentioned as a bone of the skull; however, it is a very finely-constructed mechanism. Dr. William Sutherland brought attention to the importance of these cranial bones and emphasized considering them as "dynamic, living structures."

The temporals, the zygomas, the sphenoid, palatine, and frontal bones form the orbits for the eyes. Always remember that these articulations *move* on respiration or with activity of the brain.

In fact, any kind of movement you can think of (serrated articulation, ball and socket, pivotal, rotary) takes place in these structures when the brain expands and contracts, or when respiration takes place.

Man's living structure is wonderfully made and since most of it has been studied by means of dead structure little is known of its power as an active force. There is nothing so far invented by man for uses, that is not already in use in the human body. Consider, for instance, "fluid drive" as explained in an article in the *Scientific American* by Stanley W. Angrist. Its principle is the same as the dural attachments at the torcula Herophiles and ethmid spine to control the movements of fluids within the body.

Every one of these bones should be studied by a person doing manipulative work for thier movement in connection with the spine and sac-

rum. This movement on respiration is constant, rhythmic, and essential for cellular nutrition and fluid movement throughout the body. Always remember, the body is a *dynamic instrument* capable of any task within its scope, if considered constructively. Even the sacrum is so connected with the ilia that "tacit" breathing is determinable.

At birth and throughout early childhood, none of the cranial bones articulate but are left disunited to allow the brain as well as the head to grow and expand. Ossification, as it develops, takes place from the center of the bone as rays from a center and should be well understood and studied. That would be a lecture in itself as each bone ossifies according to its uses; some bones needing several centers, others only one. I am describing mainly the adult cranium. The articulations of the skull bones are called sutures.

The first, or the frontal bone is double at birth but mostly single in adults as the two sides unite or fuse centrally early in childhood. Sometimes it is bifid or cleft, but generally it is simple. It is irregular in shape, in its connections, thickness, and internal surface where depressions and eminences may be observed. The longitudinal sinuses can be seen upon it as well as the attachments of the frontal and temporal muscles and the oblique pulley of the musculus obliquus major of the eye. There are seven epiphyses of the frontal bone, six of which join the formation of the orbits of the eye. The seventh sustains the bone of the face and articulates with the ethmoid and sphenoid, forming the frontal sinuses in adults. The frontal bone articulates with the sphenoid, malar, temporal, zygoma, palatine, and parietal bones forming the orbit and the ethmoid in front through which the crista galli passes for the attachment of the dura mater. On either side of this articulation are sieve-like plates for the excretion of the internal tissues to pass down into the nares, called the olfactory bulbs.

The use of these articulations or sutures as they are called is that:
1. the dura mater may be firmly joined to the cranium and pericranium.
2. the infant's head may expand more easily, since the bones at this time are disunited.
3. the transpiration from the brain may be freer and easier in infancy.
4. large fractures of the skull can be prevented.

The air cells or antrums in the frontal part of the head are: the sphenoid, frontal sinuses and antrum of Highmore. These vary in size with reference to sides and depth. The foramina of all the sinuses are so arranged that no matter in what direction the head is held, whether bent forward, back,

or sideways, some moisture must always flow out from some of these cavities for moistening the nose. The foramina through which the blood enters the skull are so arranged as to control this.

The cristi frontalis protrudes a little into the hollow part of the frontal sinuses or their septum. This narrow ridge with a furrow or ridge ascending upward through the middle of the frontal bone toward the sigittal suture, ascends in a straight line. At the root is the foramen caecum or spinosum which is in some cases common to the frontal bone and in others to the ethmoid, and thus communicates with the frontal sinuses.

The Bregma, where sagittal and coronal sutures meet, is *formed* by the junction of the frontal and the parietal bones. Almost square in form, these are the largest bones and form the Sinciput. The parietals form the superior and lateral parts of the Bregma, like walls. Their superior and posterior margins are serrated except for a small part on their lower side. They are joined together by the saggital suture, with the frontal bones by the coronal suture, with the occipital bone by the lamboid suture, and with the temporal bones and the sphenoid by squamous sutures. The anterior and upper angle of the parietals terminate in the form of a little squamous tongue, the Apophysis Temporalis.

Though they are the largest bones, the parietals are the weakest with the diploe between the tables and around the margin. Like all the rest of the cranial bones, the convex or external surface is smooth, the internal irregular and uneven, for there are many grooves and impressions of the arteries of the dura mater imprinted upon them. Many irregular channels are there and the groove for the longitudinal sinus as well as for glandular Pacchione are well marked. Near the lower posterior angle there appears to be a channel for the lateral sinus.

On both sides of the sagittal suture there are two small fossae in the bottom of which are several foramina through which blood vessels pass; there the dura mater is so closely attached to the skull that, unless great care is taken in dissecting this area they are easily torn and blood drops are seen. Near the superior border, toward the posterior angle, is found the *foramen parietale*. Sometimes there is one in each bone, sometimes only in one bone, and sometimes it is in the sagittal suture itself. It may terminate in the diploe. Since the foramen parietale carry off the remaining blood of the dura they may or may not be needed (Heister). There is also a foramina near their anterior and lateral inferior part through which a branch of the internal carotid supplies the dura. On the external surface above the notch of

the temples appear attachments or a considerable portion of the temporal muscle.

The parietals ossify from their center about the seventh month of foetal life. These two parietals are loosely but harmoniously drawn together, but in their articulation with the temporal and sphenoid they are mostly cartilaginous and articulate as such. The temporal bones are very irregular in shape and are composed of the squama and petrous portions. They each have four processes, the zygomatic portions of the temporal bones, the maxillary, mastoid, the styloid, and the petrous where they are articulated with the lower jaw. The squama of the temporal articulate as sliding gears on the parietal. Also we find the meatus auditoreus.

In his volume on the brain, Swedenborg states:

> In the sutures, no matter what their nature may be, there is ever inserted between the edges of the bones a thin layer of a thin, whitish substance, very much like cartilage -- cartilage suturarum -- which is continous with the external and internal periosteum, but which does not possess the least trace of a cartilaginous texture. This intervening substance consists of closely woven cellular fascicles intermixed with fine elastic fibers and a number of oblong nuclei. This organical cement contributes not a little to the great tenacity of the sutures, and it admits of their separation in a longitudinal direction, only with a great deal of difficulty. *

In the petrous portion appears the cavity of the tympanium where the four little bones of hearing are located as well as several notable foramina. The small bones are: 1) the maleolus or hammer whose head, neck, and handle are joined to the tympanium; 2) the Incus or anvil, the head of which is grooved for its articulation with the malleus and the two cura, the longer of which is joined to the 3) stapes. Here the head of the malleus is joined to the longer leg of the Incus, the basis of which is fixed upon the fenestre ovalis of the labyrinth and two lateral parts which are furrowed on the internal surface. Finally, 4) the os orbicularis, situated between the Incus and the stapes, is simply an epiphysis of the long leg of the Incus. Here there are many foramina: the foramin ovalis at the base of the stapes which leads to the concha; the foramin rotunda which leads to the vestibule; the Eustachian tube, a small canal which ends in the mouth; and another foramina which opens into

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*Swedenborg, Emanuel, *The Brain*, Vol. I.

the cells of the mastoid process. All these are involved in the sense of hearing.

The innermost part of the ear is the labyrinth, in the center of which lies the vestibule. Three canals called semi-circular canals, open into the vestibule by five orifices. On the other side is the concha which makes two spiral windings and a half. The nucleus and the rube of it are divided into two parts by a spiral lamina: the upper one Dr. Valsalve called the scala vestibuli while the lower (which by the fenestre rotunda has respect to the cavity of the tympanium) he called the scala tympani.

The articulation of the temporal, occipital, and parietal bones form triangular articulations at the meeting of the occipital and parietal areas. These are serrated internally at the point of pivot of this articulation and serrated externally as it ascends up the suture allowing a limited rotation of the temporal as it slides on the parietal bone. *This is important since any deviation in the position of the ilium affects this anteriorly*. At the articulation of sphenoid and frontal articulation of the temporal bone there is also a pivot, serrated internally on the temporal but externally on the sphenoid. This causes a slight rotation of these bones on inhalation and exhalation. The parietal and temporal follow the movement of the occipital, thus allowing the anterior and forward movement of the sphenoid and the facial bones.

The occipital bone is most important to the body as it has the foramen magnum or the foramen through which the spinal cord passes from brain to body. It is irregular in shape, the base being formed by two condyloid parts for its articulation with the upper vertebrae of the neck, thus supporting the whole head. Its third projection forms the basi-occipitalis for articulation at its anterior surface with the sphenoid. Its inner surface is grooved for the medulla oblongata, and its posterior border forms the anterior rim of the foramen magnum. The pharyngeal tubercles appear on its external portion for fascial attachments, the lateral borders are ridged for the petro-basilar articulation, and there is a partial groove for the inferior petrossal sinus. The condylar part carries about three quarters of the condyle and its fossa as well as the hypoglossal canal and foramen magnum.

The squama, or upper part of the occipital bone, is divided into the supra-occiput from the foramen magnum and extends to and above the opistion in the center and the interparietal occiput. Externally it is crossed by the nuchal lines and external occipital protruberences in the center, known as the inion. The internal surface is divided into four fossae by a ridge internally for

attachment of the falx cerebrum and cerebelli, for the hinder lobes of the cerebrum and cerebellum, with a lateral ridge for attachment of the tentorium and grooves for the transverse sinuses. These structures form a cross within the posterior part of the occiput. These two angles, known as the Asterion lie at the lambda meeting place (temporal, occipital, and parietal bones) of the two parietals and the squama occipit. It has nine ossification centers, three in the basi-occipit, one at the center and one on either side as it joins the condylar parts, two in the condylar part, two in the supra occipit, and two in the interparietal part.

The occipit articulates with the parietal bones by lambdoidal sutures, with the temporals at the posterior border of the mastoid, and with the jugular process and the lateral border of the basi-occipit by a ridge which articulates in a groove along the inferior border of the apex of the petrous portion of the temporal bone. *This is a very important articulation for motion, articulating with the sphenoid at the basi-occipital articulation*, and with the atlas or first vertebra by the condyles converging anteriorly and downward. Its articulation with the sphenoid forms the basi-occipit -- a platform for the pituitary gland.

References:

Magoun, H.I., *Osteopathy in the Cranial Field.*

Swedenborg, Emanuel, *The Brain*.