

The Trauma of Birth

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The newborn skull is designed to provide maximum accommodation to the forces of labor and minimum trauma to the developing brain. However, injury to the head during birth is more common than many people realize.

In a study of 1,250 newborns I conducted a few years ago, it could be demonstrated that severe visible trauma was inflicted on the head--either before or during labor--in 10 percent of the infants. Membranous articular strains, which could be detected by the physician proficient in the diagnostic techniques of osteopathy in the cranial field, were present in another 78 percent. Thus, nearly nine of every 10 infants in the study had been affected. (1)

How important are these membranous articular strains to the physician? I have found that common problems of the neonatal period--such as difficulty in sucking, vomiting, nervous tension, and irregular respiration--are frequently overcome just as soon as these strains are corrected. Similar strains are encountered in school children who have learning and behavior problems.

In a study of 100 children between the ages of five and 14 who were having learning or behavioral difficulties, it was found that 79 had been born after a long or difficult labor and had one or more of the common symptoms of the neonatal period. Also, it is my impression that many cases of childhood allergy can be traced to musculoskeletal strains originating at the time of birth. (2) And vertebral scoliosis occurring in childhood and adolescence is, in many instances, the consequence of cranial scoliosis originating during birth. (3) Thus, recognition and treatment of dysfunction of the craniosacral mechanism in the immediate postnatal period represent one of the most, if not the most, important phases of preventive medicine in the practice of osteopathic medicine.

To gain a clearer understanding of the origin and nature of these membranous articular strains, it will be helpful to review the anatomic features of the newborn skull and to note how they are affected by the forces of labor.

Labor

As was mentioned above, the newborn skull is designed to provide maximum accommodation to the forces of labor, minimum trauma to the infant's brain, and complete restoration to free mobility of all its parts once the stress of labor is over.

Just before birth, the infant in utero is positioned for delivery by presenting the smallest diameter of his head to the largest diameter of the mother's pelvis; this is the position of full fetal flexion. As contractions continue, the infant is conducted by the inclination of the maternal pelvic floor into the midline for delivery around the pubic symphysis by a process of extension of the head.

This descent in full flexion, progressing to birth by extension of the head, is of profound significance to the initiation of pulmonary respiration. The respiratory activity associated with the vigorous vocal activity of the newborn serves to expand the cranial mechanism and restore the bones and membranes to their anatomic relationships (permitting their free physiologic motion). Healthy sequential development of the central nervous system within can then continue.

These ideal circumstances, however, seldom occur in our modern, civilized world. Owing to such factors as poor nutrition of the mother, structural inadequacies before and during pregnancy, drug abuse, inadequate preparations for labor, and, sometimes, the mechanical or artificial acceleration of labor by an impatient obstetrician, only a relatively few infants are born without undue strain or cranial trauma.

Instead, structural inadequacies of the maternal pelvis may cause the fetus to assume a degree of extension (and lateral cervical flexion) greater than the ideal; the result will be a presentation of a portion of the head greater than the minimum occipitobregmatic diameter. This can range from a moderate extension to posterior occiput, to transverse arrest, to brow presentation, or even to a complete extension in which the face itself presents--a position in which vaginal delivery is impossible. In such a circumstance, cesarean section will be necessary if the baby is to survive.

But the compressive forces will have already traumatized the head as the uterine contractions force it progressively towards the birth canal. Prominence of the base of an anterior maternal sacrum may obstruct descent of the head on one side, and such asynclitism can distort the cranial mechanism. The presence of large twins, both striving to present the head at the same time, may cause cranial stress to one or both even before active labor begins. These are only a few of the mechanical insults that may occur before birth.

So much for the passage of the infant into the birth canal. Now let us consider the structure of the infant skull itself at the time of birth.

Anatomy

The vault of the newborn skull is a membranous structure. Plates of bone are enveloped in two layers of membrane, which are in apposition at the anterior and posterior fontanelles and sometimes at the pterion and asterion. These plates of membranous bone are designed to telescope into each other as the skull passes through the birth canal—the parietals overriding the frontal at the coronal suture, and the occiput at the lambdoid suture. The degree of this overriding is controlled and limited by the investing aural membranes.

The bones of the base develop from the cartilaginous chondrocranium. At birth, development is still incomplete.(4) The occipital bone is in four parts, united by intraosseous articular cartilage. The spheroid is in three parts, the temporal in two, the maxilla in two, the frontal frequently in two.

The cranial suture is designed for a very small but vital degree of motion.(5) How much greater is the potential motion of the bones of the developing newborn skull! At this time each part of each of these bones functions virtually as a separate bone, moving in relation to its other parts.

Let us consider the occiput. It is most commonly the presenting part, and therefore the part that may take the brunt of the trauma of labor. The four developmental parts surround the foremen magnum. The base articulates anteriorly with the base of the spheroid. Posterolaterally, it articulates with the lateral masses. The hypoglossal nerve, which innervates the muscles of the tongue, passes out of the skull between the base and the lateral mass, through the intraosseous cartilage in the space that will become the condylar canal. The occipital condyle, which articulates with the atlas, spans the intraosseous cartilage; its anteromedial third is found on the base, the posterolateral two-thirds on the lateral mass.

Immediately anterolateral to this condylar area is the jugular foremen, a space between the condylar part of the occiput and the petrous portion of the temporal. This foremen gives passage not only to the jugular vein but also to cranial nerves IX, X, and XI (glossopharyngeus, vague, and accessorius, respectively). The vagus nerve provides innervation to the gastrointestinal and cardiorespiratory systems.

The supraocciput formed in cartilage fuses with the membranous interparietal bone to form the occipital squama. Compression transmitted through the squama to the condylar part on one side may disturb the function of the vagus and/or hypoglossal nerve, causing vomiting, irregular respiration, and difficulty in sucking. If this compression is transmitted further to the base, the relationship of the base of the occiput to the base of the spheroid may be distorted, causing a lateral strain of the sphenobasilar articulation and a parallelogram deformity of the cranium(5) (Figure 1).

Figure 1. Lateral strain of the sphenobasilar articulation. Viewed from above, the sphenobasilar symphysis has been strained (displaced), with the basisphenoid moving to one side and the basiocciput to the other. Both bones side-bend about parallel vertical axes in the same direction. The lesion is named from the position of the basisphenoid: lateral strain with the spheroid to the right, etc. (From Magoun, H. *Osteopathy in the Cranial Field*.)

Bilateral condylar compression may cause a buckling type of strain of the cranial base, producing a vertical strain between the occiput and the spheroid at the sphenobasilar articulation. This may be associated not only with vagal dysfunction but also with symptoms of tension, spasticity, opisthotonic spasms, sleeplessness, and excessive crying due to the irritation of the pyramidal tracts on the anterior and lateral aspects of the brain stem in the foremen magnum. This should be considered as a precursor of the spastic type of cerebral palsy.

The spheroid bone is in three parts at birth; the central body bears the lesser wings, with the greater wings (from which the pterygoid process subtends) on either side. The greater wing-ptyerygoid unit articulates with the body by an intraosseous cartilage. This is situated immediately beneath the cavernous sinus, through which pass cranial nerves III, IV, and VI, innervating the extraocular muscles, and the ophthalmic division of V, which is sensory to the orbit, upper face and scalp. The body of the spheroid articulates with the base of the occiput posteriorly and is therefore distorted by the lateral or vertical strains resulting from condylar compression. Anteriorly the body carries the lesser wings, which enter into the formation of the orbit. The orbit is approximately pyramidal in shape; the apex is at the optic foremen—that is, the root of the lesser wing at the body. Its anatomic integrity is dependent on the relationship of the greater wing to the lesser wing, which is in fact the relationship of the greater wing-ptyerygoid unit to the body.

In the event of a lateral strain at the base due to unilateral condylar compression of the occiput, the orbit will be distorted by rotation of the

base of the spheroid carrying the lesser wing anterior on one side and posterior on the other. In the parallelogram head due to lateral compression, the greater wing is compressed medially and carried forward on one side and posterior on the other. In either event, lateral muscle imbalance of the eyes is commonly found in varying degrees ranging from mild esophoria or exophoria to severe strabismus.

The temporal bone is in two parts at the time of birth -the petromastoid portion, developed in cartilage that projects obliquely between the occiput and the greater wing of the spheroid to articulate at its apex with the body of the spheroid, and the squamous portion, developed in membrane the forms the greater part of the lower lateral wall of the skull. The tympanic portion is not yet a bony canal but resembles a horseshoe adherent to the inferior posterior aspect of the squama. These two parts, the squamous and tympanic, unite just before birth. The petromastoid portion contains the auditory and the vestibular apparatus.

The auditory apparatus consists of the bony eustachian tube emerging between the petrous and squamous portions, from which the cartilaginous tube extends to the fossa of Rosenmuller. The eustachian tube is susceptible to distortion, which may impair hearing if lateral stress compresses the squamous portion. Laterally the eustachian tube opens into the middle ear, which, by the ossicular mechanism, transmits the auditory vibrations received from the tympanic membrane to the internal ear. The vestibular apparatus includes the semicircular canals, precisely related to each other and geometrically balanced with those of the opposite side. Distortion of the axis of the petrous portion may disturb this delicate mechanism of equilibrium.

The maxilla develops in two parts-the premaxilla, which will give origin to the incisor teeth, and the body, which carries the canine and all the other upper teeth. Angulation between these two developmental parts of the maxilla gives rise to malalignment and malocclusion in later years.

Thus far our consideration has been directed to certain structural changes that may sometimes be visible and are always palpable following various difficulties of labor. Radiologic techniques have been developed to substantiate many of these palpatory observations and confirm their persistence in childhood problems.(7)

Examination

The craniosacral mechanism of the newborn infant should be examined within the first few days of life. There is probably no field of osteopathic diagnosis where the injunction "if at first you don't succeed, try, try again" applies more than in the examination of the newborn cranium. The mobility of the cranial mechanism is much greater at this age than it is in the adult skull, although the range of motion is of course much smaller. Dr. R. McFarlane Tilley used to speak of the amplification mechanism within the human hand and brain, which permits the perception of motion in the range of 0.0001 inch. It is this perceptive mechanism that must be developed in order to make a meaningful examination and to complete an adequate treatment program for these infants.

Furthermore, one must learn to palpate motion within motion, for these infants rarely lie absolutely still for an examination. One should first consider the contours and articulations by passing the hands gently over the surface. Look for asymmetry, bossing of the frontals or parietals, grooves above the eyebrows, overlapping of one bone on the other at the coronal or lambdoid suture, prominence and compression of the sagittal or metopic suture, and depression of the pterion. Let the occiput rest in the palm of the hand, and note unusual prominence of the interparietal occiput or hard flattening of the supraocciput. Study the relative size and position of the eyes and nostrils and the inclination of the mouth. Examination for inherent motility will be facilitated if the baby is nursing or sleeping. Here is a check list that may be helpful:

1. Place the hands gently on the vault, with the index fingers on the greater wing of the spheroid and the little fingers on the lateral angles of the occiput. The other fingers lie comfortably between them. Is your first palpatory impression that your two hands are symmetrical?
2. Are the index finger and the little finger of one hand cephalad or superior to those of the other, as in a torsion strain. If so, the spheroid and occiput will have rotated around an anteroposterior axis in opposite directions, elevating the greater wing of the spheroid on one side and the lateral angle of the occiput on the other (Figure 2).

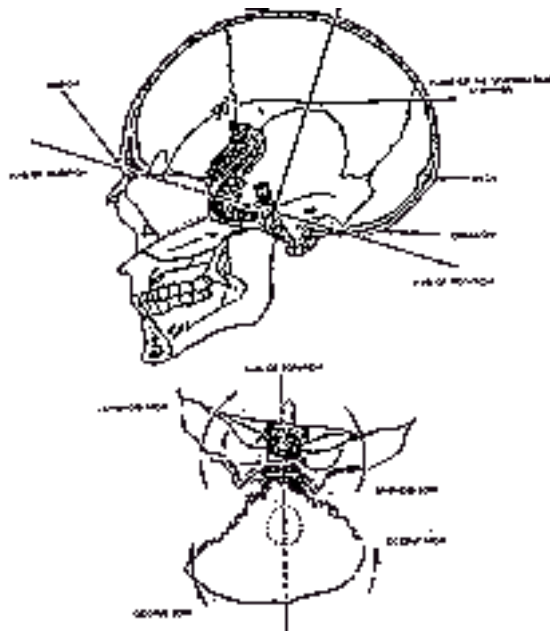


Figure 2. Torsion strain. Torsion of the sphenobasilar symphysis occurs about an axis running from the nasion (anterosuperior) to opisthion (posteroinferior) at approximately right angles to the plane of the sphenobasilar symphysis. In bottom view, a left torsion lesion is diagrammed, with the greater wing and basisphenoid high on the left side and the basiocciput and squama lower on that same side. (From Magoun, H. *Osteopathy in the Cranial Field*, Second Edition. Kirksville, Mo.: Journal Printing Company, 1966).

3. Are the index finger and little finger of one hand caudad or inferior to those of the other hand, with a sense of fullness in the palm of the inferior hand, as in a side-bending rotation strain. In this instance, the spheroid and occiput have side-bent in opposite directions around parallel vertical axes and rotated inferiorly into the convexity thus created.

4. Is there a sensation that the index fingers on the greater wings are directed towards one side, while the little fingers on the occiput are carried to the other side? This is lateral strain (Figure 1). Owing to a lateral force, the spheroid and the occiput have rotated in the same direction around parallel vertical axes, causing a shearing strain at the symphysis between them.

5. Are the two index fingers on the greater wings forward and downward (caudad) as compared with the little fingers on the lateral angles? Conversely, the index fingers may be superior (cephalad). These are vertical strains (Figure 3). Both superior and inferior strains are shown in the diagrams (superior on the left). The spheroid and the occiput have rotated in the same direction around parallel transverse axes, producing a vertical shearing strain at the sphenobasilar articulation.

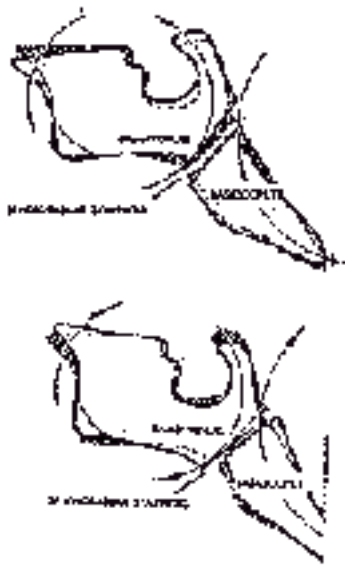


Figure 3. Vertical strains of the sphenobasilar symphysis. Viewed from the side, the sphenobasilar symphysis has been strained or displaced before ossification, with the basisphenoid moving cephalad (flexion) and the basiocciput moving caudad (extension), or vice versa. Both bones rotate about parallel transverse axes in the same direction. (From Magoun, H. *Osteopathy in the Cranial Field* Second Edition. Kirksville, Mo.: Journal Printing Company, 1966.

6. Is there a sense of hardness and tension under your hands, resembling wood? This suggests a compression strain.

These palpatory observations of asymmetry are clues to the dysfunction of this mechanism: But it is the nature of the inherent cranial rhythmic impulse-its symmetry, rate, amplitude, and constancy of pattern- that is important. If the inherent motion is distorted, impeded, limited, or retarded, there are certainly membranous strains that need attention.

It is not possible to develop the necessary tactile skills in a few days or during a brief course of instruction. But with assiduous application, the sensitivity will be developed, and you will be able to make these vital diagnoses at the age when they are most susceptible to correction.

7. With your index finger on the greater wing of the spheroid and your little finger on the lateral angle of the occiput, be still and permit the mechanism to convey its movement through your fingers and hands. Is there rhythmic, symmetric expansion and contraction of **external and internal rotation** of the bilateral vault bones that accommodates the **flexion and extension** of the spheroid and occiput? (This is transmitted to the index fingers as a rhythmic downward and forward and then upward and backward cyclic motion, while the little fingers also move downward and backward, then upward and forward.) Is the direction of motion that of the torsion, side-bending rotation, vertical or lateral strains?

8. Cradle the occiput in the hands, and place the tip of the index fingers on the mastoid process of the temporal bone bilaterally. (While there is no bony mastoid process at birth, the attachment of the sternomastoid muscle provides the palpatory landmark.) Is the sensation that of symmetry, or does one fingertip seem posteromedial to the other? If the tip of the mastoid is posteromedial (i.e., less prominent) the temporal bone is externally rotated. If it is anterolateral (more prominent), the temporal bone is internally rotated. This asymmetry of the mastoid process is indicative of the position of the occiput, with the internally rotated temporal bone or the prominent mastoid process being associated with the elevated lateral angle of the occiput. Is one temporal bone more anterior than the other without the medial or lateral motion? This suggests a lateral strain of the sphenobasilar articulation that has carried the head into a parallelogram distortion. Again, be still, and observe the relative mobility of the two temporal bones.

9. Steadying the head with the two fingers gently on the frontal bone, slip the other hand down and around the curve of the prominence of the occiput. Two fingers are usually adequate. Note the tension of the suboccipital muscles, and compare the two sides of the midline. Does one of the two palpating fingers come in contact with the arch of the atlas before the other? If it does, this is probably the side of condylar compression, for the occiput will have rotated anteriorly on this side. Be still, and observe the motility. Impaired motion on one side or both will suggest, respectively, unilateral or bilateral condylar compression.

10. By now the baby may have finished nursing and may even be asleep. Now change your position, and sit at the infant's right side, at the level of his lower limbs. Steady the pelvis with the left hand while placing two fingers of the right hand under the sacrum. Are the two sides of the body symmetrical? Does the sacrum project into the hand at the coccyx? Be still; observe the motion of the sacrum in relation to the ilia. Is the motion symmetrical, around a transverse axis? Or do you find a rotating motion superiorly on one side, around an anteroposterior axis?

11. Place the hands under the lumbar spine, and note the presence of lateral flexion producing a concavity to one side. Relate this to lateral motion of the pelvis.

The treatment of the craniosacral mechanism cannot be learned solely from the written word. The palpatory skills must be developed and evaluated with supervised experience. But the treatment, in summary, consists of finding the point of balanced membranous tension of the mechanism, holding it, and permitting the inherent therapeutic force within to normalize the body.

"The osteopath reasons that order and health are inseparable," said Dr. Andrew Taylor Still, "and that when order in all parts is found, disease cannot prevail." And as Dr. W. G. Sutherland reminded his students, as the twig is bent, so the tree is inclined.

Give attention to those little bent twigs, so that they may grow into handsome, healthy, happy generations for the future.

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Page Modified May 15, 2011