Learning difficulties of children viewed in the light of the osteopathic concept

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Skeletal distortion due to trauma at birth or during infancy may play a part in the learning problems of children. Recent studies in the development of the brain indicate that the first two years of life are the most vulnerable period and that the growth of the central nervous system during this period will be influenced by the integrity of the fibro-osseous case that surrounds it. Traumatic distortion of this case, the cranial-vertebral-sacral mechanism, may be discovered long after it occurs, when learning problems provoke the physician to search for it. Its correction in infancy promises to be prophylactic. Osteopathic manipulation as a therapeutic measure offers the best prognosis in the early years of childhood, but older children also can be helped to attain their maximum potential.

Many factors have been incriminated from time to time in learning problems of children. Among them are heredity,[1] trauma,[2] malnutrition,[3] hypoglycemia,[4] allergies,[4] perceptual dysfunction,[5] psychologic stress at home, and past failures at school.[7] Almost all these factors were involved in the following case:

Case 1. A girl 12 years of age (Fig. 1A) did not want to go to school because she could not cope with a classroom situation. She had difficulty in spelling and comprehension. In mathematics she was at third grade level. Reading was difficult and recall poor.

She had been frightened by her kindergarten teacher. In first grade she was ignored, and the second grade had to be repeated. By the time she reached sixth grade she was almost a dropout.

She was the first and only child of a highly nervous, neurotic 35-year-old mother. A "miserable" pregnancy for 9½ months, five nights of false labor, and 15 hours of hard, unproductive labor were followed by cesarean section.

The infant's head was severely compressed. Respiration was delayed. She experienced much vomiting in the neonatal period and through the first year. At 18 months she began having severe episodes of abdominal pain. Appendectomy was performed in her sixth year, but she still had frequent bouts of abdominal pain.

Myopia was recognized when she was 4 years of age. Headaches developed at the age of 10.

Asthma and eczema were recent developments. Her appetite was described as "lousy," and her diet consisted of refined cereals, abundant white sugar and candy, processed foods, meat and mashed potatoes, hamburgers and burritos, rarely a salad, and never fresh fruit. Constipation was a chronic problem.

At the age of 2 years she had fallen out of the stroller on her head. Her father had had difficulty in learning to read. There was a strong family history of allergic asthma.

The psychologic environment was tense, insecure, negative, and depressing. A 5-hour glucose tolerance test revealed reactive hypoglycemia.

A treatment program was developed to eliminate the musculoskeletal effects of the trauma, to improve nutrition and overcome the hypoglycemia and the allergies, to re-educate perceptual functions, and to make the home situation more secure and harmonious and the academic climate more productive and acceptable than it had been.

Within 10 months the report from school was of "immeasurable improvement" (Fig. 1B).

Most of the aforementioned contributory factors have been discussed in professional and popular literature, but the specific effects of perinatal trauma have been only surmised. Rosenberg and Weller[8] reviewed the literature and expressed the opinion that in many children the academic difficulties in school result from undiagnosed prenatal or perinatal damage. Furthermore it is a clinical impression[8,10] that osteopathic structural diagnosis and treatment of dysfunction within the cranio-sacral mechanism make a significant contribution to the prevention and amelioration of learning disabilities in children.

Present study

In the hope of shedding some light on the problem and making a contribution to its alleviation, a study was undertaken to seek answers to the following questions:

Fig. 1A (Case 1). Twelve-year-old girl on November 1, 1971, before treatment. Fig. 1B. After treatment on January 19, 1972. Note the improvement in expression, the position of the head on the neck, and the relative widening of the face as compared to the height following treatment.

1. Is there a significant difference in birth and early development between children with and without learning problems?
2. Is there a distinctive traumatic pattern within the craniosacral mechanism of children with learning problems?
3. Is there significance in the time at which the trauma occurred?

Clinical material was drawn from my private practice and consists of case histories from an unselected series of patients between the ages of 4 and 14 years in the following categories:

Group 1 consisted of 74 average or above-average students without visual or learning problems who sought medical care for a variety of common maladies.

Group 2 included 32 average or above-average students with visual problems such as myopia, hyperopia, esophoria, and exophoria but no learning problems who sought medical care for a similar variety of common maladies.

Group 3 was made up of 105 children who were having problems at school because they could not learn in the customary fashion required by established educational programs.

Definition of problem

The term "learning difficulty" is neither finite nor precise, but it encompasses the great diversity of conditions which may underlie the academic inadequacy. Bowley[1] suggested that the number of children with reading difficulties, clumsiness, and perceptual difficulties far exceeds the number with uncomplicated specific developmental dyslexia.

In modern society reading is an indispensable skill. It is the compelling cry of every parent: "But he must learn to read; he cannot get on in life if he cannot read." Many famous men of history, including Winston Churchill, Bernard Shaw, and Leonardo da Vinci, had great difficulty in learning to read. They were regarded as miserable failures during their early life, and their parents undoubtedly suffered the despair and anxiety known only to

those whose children cannot learn to read.

Learning may be envisioned as an iceberg of human experience. Achievement in all spheres of endeavor is the visible edifice of ice. At the waterline is the ability to read, for there are few occupations in life in which reading is not an essential skill. Yet hidden beneath the sea of "normal development" are to be found the innumerable complex developmental steps that provide the mechanism out of which reading will emerge.

Birth and early development

The newborn baby with two healthy eyes and a competent central nervous system receives the patterns of light, shade, and color on the retina and transmits them through the optic pathways of the brain. But days or weeks elapse before the two-way communication function called vision is established. Its date can be recorded precisely: This is the day he looks at his mother and suddenly smiles. In this first simple experience a complex circuit has transmitted the optical image from the sensitive receiving retina to the interpreting cerebral cortex, where it has been integrated with former input called memory and now has set in motion via the motor cortex and tracts to the facial nucleus a response observed in happy movements of the facial muscles. By the age of 10 or 12 weeks a circuit has developed to include a reaching response with the upper limbs, movement to the mouth, and all the coordinated activities of sucking and swallowing.

At approximately 9 or 10 months the whole body and the lower extremities have been incorporated into this vision circuit, and the baby sees, reaches, gets up on hands and knees, and with a smoothly integrated motion of head, neck, shoulders, upper extremities, thorax, spinal complex, pelvis, and lower extremities he crawls to the desired object. The complexity of this common activity is not appreciated until one is confronted with the child who cannot crawl, who cannot integrate arm and leg movements in this harmonious reciprocity. Herein is the first breakdown in this visual system.

By approximately 12 months of age the healthy child has discovered a world above him. He pulls himself to his feet, stands, walks, runs, and begins to climb. The child who could not crawl also may respond to the visual attractions above him, but the complex coordinated pathways involved in crawling have not been fully established. He lacks the delicate, coordinated, harmonious musculoskeletal interaction necessary for balance. He falls excessively; he cannot move his body adroitly around objects or through doors. He begins to experience frustration with his own inadequacies. His parents are provoked because he is "clumsy."

Imitation is another response in the visual communication circuit whereby a child learns many skills including that of speech. Children who do not see the activities of lips, teeth, and face in speech are slow in learning to talk. Furthermore, speech is but another in the visual circuit. The child sees something he cannot reach and calls it or asks for it. He sees something exciting, and he must talk about it.

Speech is an intricately coordinated, harmoniously integrated neuromuscular activity that follows the mastery of walking, and also may be delayed or impaired if there has been incomplete or distorted development in the past.

The visual circuit may evoke an emotional reaction of tears or laughter, aggression or withdrawal. It may stimulate intellectual curiosity manifested as taking apart and later putting together. However, such skills require an awareness of spatial relations, directions such as up, down, left, right, forward, and backward. Construction necessitates the recognition of shape, form, and size, the integration of certain objects into appropriate spaces. This is a further addition to the visual circuit. The child who cannot recognize forms and spaces will not attempt jigsaw puzzles; if he lacks an awareness of directions in space he will avoid construction projects. Furthermore, he will have difficulty in catching a ball, throwing it in the right direction, or jumping rope.

By the time he is 5 years of age he will be expected to recognize smaller, more complicated shapes

called letters and numbers. He will be required to copy such forms in the mastery of writing. To perform adequately in these skills there must be two healthy eyes so coordinated that they provide one discrete image to be transmitted to the visual cortex.

Pupillary accommodation to light and distance and delicate precise extraocular muscle coordination to focus both eyes on the object and to provide accurate awareness of depth are a few of the essential ocular functions which depend on integrated nervous activity from the upper thoracic segments through the brainstem, the nuclei, and the pathways of the second, third, fourth, sixth cranial nerves and the ophthalmic division of the fifth, the optic tracts, the association pathways, and the occipital cortex. Furthermore, these pathways must interact harmoniously with the cervical and pectoral mechanism, the upper limb, and in fact the posture of the whole body.

Reading involves recognition, interpretation, recollection, and comprehension of a sequence of complex configurations made possible by a smooth movement of both eyes from left to right along a line of print and the transmission of the impulses through the pathways described to the interpretive areas of the cerebrum relating them to other impressions stored within the memory and delivering them to consciousness as information requiring action. The response may be intellectual (interest), emotional (joy, sorrow, anger, or inspiration), or physical (speech, writing, or action).

Unless there are gross deficiencies in this visual mechanism, perceptual dysfunction rarely is discovered until the child enters prereading activities in school. The earlier inadequacies usually are not recognized as a part of this learning pattern. In kindergarten he does not learn the alphabet or he confuses *d* and *b*, *p* and *q*. He cannot count in sequence or recognize the numbers. He has little success with puzzles and therefore does not attempt them. Then, finding he cannot participate successfully in the planned program, he begins to look for something to do and a companion with whom to do it.

On the playground life is little better, since he cannot catch the ball, throws it in the wrong direction, and cannot jump rope or even play hopscotch. The report comes home that he is "immature" or "hyperactive" or "a disturbing influence not yet ready for first grade." Either he is subjected to the humiliation of another even more frustrating year in kindergarten or he finds on promotion that his difficulties are compounded because he cannot read the alphabet, cannot recognize words, cannot draw within the line, and has no concept of numbers. Overnight, it seems, he has become a failure, a misfit, a problem to his teacher, and a disappointment to his parents.

Several more years of his life may pass before the real problem is recognized and even more time before an adequate remedial program is instituted. Meanwhile the habit of failure may become so deeply ingrained that it is difficult to overcome even when enlightened helpers are found.

Gordon[3] referred to the results of a survey of British schools by Bremner and associates[19] and exclaimed:

> If over 6 percent of children in primary schools have a significant perceptuo-motor disorder surely we as doctors must devote a major effort in trying to find the reasons for this.

The majority of elementary schools in the United States have at least one child with such difficulty in every class. This is a common problem. It demands attention.

In my series of children, the birth history was studied to determine whether there was any significant difference in the incidence of traumatic or biochemical disturbances in Groups 1 and 2 compared with Group 3. Such disturbances are shown in Table 1.

The discovery that 72.8 percent of infants in whom learning problems later developed had suffered some considerable trauma before or during birth, compared to 28.3 percent of those without learning problems, was arresting. Furthermore, the

TABLE 1. COMPLICATIONS IN BIRTH HISTORY

Group	Total number of children	Prolonged labor (12 hours or more)	False or ineffectual labor (followed by cesarean section	Version or persistent posterior occipital presentation; manual dilation of cervix	Deformity of head	Neonatal difficulty other than jaundice	Prematurity (2 1/2 or more)	Postmaturity (2 1/2 or more)	Neonatal jaundice	Illness or ingestion of drugs by mother during pregnancy	Number of children
1	74	10	2	—	4	5	6	—	—	3	23 (31.1%)
2	32	2	—	—	—	2	2	—	—	—	7 (21.9%)
1&2	106	12	3	—	4	5	8	—	—	3	30 (28.3%)
3	103	54	23	4	25	8	16	9	5	23	75 (72.8%)

degrees of difficulty and trauma were of far greater intensity for those in Group 3. For example, 20 children in Group 3 (19.4 percent) were born after a labor of 24 hours or longer, while only 3 (2.9 percent) in Groups 1 and 2 had this history. Long periods of false or ineffectual labor culminating in cesarean section were recorded for 23 (22.3 percent) children in Group 3 and in only 3 (2.8 percent) in Groups 1 and 2. Deformity of the infant's head sufficiently severe for the mother to remember it was noted for 25 (24.2 percent) children in Group 3 and in only 4 (3.8 percent) in Groups 1 and 2.

The history of cranial trauma during the first 2 years of life is unreliable, since most accidents are forgotten unless the child required sutures, casting for a fracture, or hospitalization for concussion. Significant trauma may not compel that kind of attention, however. The physiologic function of the craniosacral mechanism may be distorted or impaired by an injury the symptoms of which may develop gradually, and their relation to the injury may not be apparent to the parent.

Accidents that could be recalled are shown in Table 2. At first glance it might be concluded that there was no significant difference between the incidence of trauma among children in Groups 1 and 2, without learning problems (27.4 percent), and among those in Group 3, with learning problems (30.1 percent). However, infants in Group 2 with visual impairment suffered almost double the incidence of injury of those in Group 1, without such impairment. Undoubtedly some of the accidents could be attributed to the visual deficiency, but some accidents in themselves might have contributed to the visual problem. The higher incidence of accidents in Group 3 may have been the result of perceptual dysfunction but also may have contributed to it.

In a few instances the parents recalled that a child's performance and behavior markedly deteriorated after an accident. Two of the children were 5 years of age and two were 9 years old at the time they sustained head injuries sufficient to cause shock or unconsciousness. In two children, 1 and 2 years old, respectively, at the time of injury, hyperactivity and behavior problems developed soon afterward, and later there were learning difficulties in school.

TABLE 2. ACCIDENTS EARLY IN CHILDHOOD

Group	No. of children	Accidents up to age 2	Accidents after age 3
1	74	16 (21.6%)	17 (23%)
2	32	13 (40.6%)	8 (25%)
1&2	106	29 (27.4%)	25 (23.6%)
3	103	31 (30.1%)	65 (63.1%)

The incidence of accidents after the age of 3 (Table 2) to children with learning problems (Group 3) was almost triple that in the other groups. Furthermore, the severity and frequency of those accidents were greater. This may be interpreted as a result of the incoordination and perceptual dysfunction associated with the learning disability.

The second question to be explored was whether a strain pattern that was unique or different from those of other children could be diagnosed by palpation within the craniosacral mechanism of the child with a learning problem. A glance at Table 3 makes it abundantly clear that all the various strain patterns may be observed in all groups of children. However, with the exception of right and left side-bending rotation, all the strains were seen in significantly greater numbers in the children with learning difficulties and in children with visual problems than in children without these problems. The significance of these strains to the visual problem will be dis-

TABLE 1 INCIDENCE OF CRANIOSACRAL TRAUMA

	Group 3 (103 children with learning problems)		Group 2 (32 children with visual problems)		Groups 1 & 2 (106 children without learning problems)		Group 1 (34 children without visual or learning problems)	
Left torsion	35 (34%)		9 (28.1%)		26 (24.5%)		13 (23%)	
Right torsion	28 (25.2%)		9 (28.1%)		17 (16%)		8 (10.8%)	
Left side-bending rotation	12 (11.7%)		2 (6.3%)		13 (12.3%)		11 (14.9%)	
Right side-bending rotation	28 (27.2%)		8 (25%)		29 (27.4%)		21 (28.4%)	
Lateral strain to left	41 (39.8%)	86.4%	12 (37.5%)	84.4%	34 (32%)	70.7%	22 (29.7%)	64.9%
Lateral strain to right	46 (44.7%)		14 (43.8%)		39 (36.8%)		25 (35.8%)	
Alternating lateral strain	2 (1.9%)		1 (3.1%)		2 (1.9%)		1 (1.4%)	
Vertical strain (superior)	37 (35.9%)	46.5%	10 (31.2%)	40.6%	31 (29.2%)	37.3%	21 (28.4%)	36.5%
Vertical strain (inferior)	9 (8.7%)		3 (9.4%)		9 (8.5%)		6 (8.1%)	
Alternating vertical strain	2 (1.9%)		0		0		0	
Compression	42 (40.8%)		12 (37.5%)		34 (32%)		22 (29.7%)	

cussed in another article. A detailed description of the various strain patterns has been published elsewhere.[13]

At this point in the research it was recognized that, although there was no significant difference in the nature of the strain patterns in children between the ages of 4 and 14 with and without learning difficulties, the incidence of trauma in the perinatal period was distinctly greater. The third question to be answered, therefore, concerned the significance of the time in life at which the strain patterns were created. Were the effects of trauma in the perinatal period, that is, the craniosacral strains resulting from a long and difficult labor, different from the effects of similar strains produced later in life?

Recent studies in the development of the brain,[14] conducted primarily to discover "whether undernutrition during certain stages of brain development can contribute to lasting behavioral changes," have provided some significant answers that are relevant to the problems of learning in children. Dobbing and Smart[14] identified the question that needs to be answered as follows:

> whether . . . growth retardation, among the multitude of other important early environmental factors, can be identified as a contributor to the algebraic sum of those influences which determine adult "attainment."

I would go one step further and question whether distortion of skeletal structure may be one factor underlying growth retardation. These are profound and challenging questions, but they are fundamental to a comprehension of the measures that will reach toward the cause of children's problems.

Dobbing and Smart[14] first examined:

> . . . the proposition that there are periods of heightened vulnerability in the physical development of the brain, during which growth retardation results in long-lasting distortions and deficits in adult brain structure.

These are quantitative disorders of the brain's growth program. They recognized the possibility that "some cases of hitherto unclassified mental retardation may show such quantitative . . . pathologys." In the study of the science of developmental nutrition with which Dobbing and Smart were concerned, three interrelated parameters were recognized, namely, the severity, duration, and time of undernutrition. They said that the importance of the third factor, namely, the age at which undernutrition occurs, has given rise to the idea that there are transient periods of heightened sensitivity which resemble the sensitive periods during the development of behavior. The term "vulnerable" has been used to describe such periods "to imply both lasting distortion and lasting deficit," they said.

Differentiation between the period of mitotic cell multiplication and the later phase of cell growth was emphasized. The authors suggested the possibility that a numeric neuronal cell deficit might not be as significant for brain function as a deficit in subsequent dendritic branching and in the establishment of synaptic connections. These are the brain's equivalents of the growth in cell size recognized for other organs of the body. The term "growth-spurt" has been employed to identify the transient period of high growth velocity. Dobbing and Smart[14] said:

> The brain growth-spurt begins at about the time neuroblast multiplication ends, and the adult number of neurons has already been almost achieved. This is towards the end of the second human (fetal) trimester . . . . It ends with the end of the major period of rapid myelination, at about two years of human postnatal age.

Dobbing and Sands[15] showed that the brain growth-spurt is obliged to occur at a predetermined chronologic age even when conditions are unfavorable. The effect of nutritional retardation is to reduce the extent of the brain growth processes, not to delay their occurrence.

The vulnerable period for the human infant includes the third trimester of fetal life and the first 18 to 24 months of postnatal life.[14] Thus, only one eighth of the vulnerable period is intrauterine. Dobbing and Smart[14] said:

> Much will therefore depend on the growth rate during the remaining seven-eighths or so of the human brain growth-spurt. *Thus the first one and a half years of postnatal life becomes a period not of vulnerability but of opportunity.* [Italics supplied]

Opportunity for what? How can this opportunity be utilized to the utmost to prevent, or at least reduce, the learning disabilities of children? The establishment of a serene, harmonious, secure, and positive emotional and mental environment in which to receive and raise the child is vitally important. A pure chemical atmosphere free from pollution with smog, toxic insecticides and fertilizers, tobacco smoke, and other by-products of this industrial age also is essential. Furthermore, a wholesome internal biochemical environment created by unadulterated, unprocessed, uncontaminated whole natural foods provided in balanced proportions is vital to providing optimal conditions in this period of opportunity.

These aspects, essential as they are, will not be discussed in this paper, for my concern here is not with the atmosphere with which the child is surrounded or the nutrition from which he must build his organism, but with the pattern and performance of the neuromusculoskeletal system in which and with which he must live and express himself. Growth of the central nervous system is one of its most important functions in the first 2 years of life. This growth will be influenced by the integrity of the fibro-osseous case that surrounds it, namely, the cranial-vertebral-sacral mechanism.

Anatomy

Some anatomic features of the newborn skull are pertinent. According to Gray,[16] the sphenoid bone at birth is in three developmental parts, a central one consisting of the body and lesser wings and two lateral ones, each comprising a greater wing and pterygoid process. These three parts may be lesioned relative to each other prior to the time of fusion at approximately 1 year of age. The superior orbital fissure is that space between the greater and the lesser wing through which pass all the nerves to the extraocular muscles, the third, fourth, and sixth. The autonomic supply also follows this pathway, as does the venous drainage. The tendinous ring of origin of the four rectus muscles of the eye is attached to the roots of the lesser wing and the margin of the greater wing. Thus, the intraorbital neuromuscular function will be influenced by the functional-structural relation of the developing sphenoid bone.

A lateral strain of the base of the sphenoid bone relative to the base of the occiput caused by intrauterine pressure, natal stress, or early postnatal trauma not only is a shearing strain at the articulation between the body of the sphenoid bone and the base of the occiput, but it creates an intraosseous lesion at the developmental intraosseous cartilaginous joint between the greater wing pterygoid unit and the body on the side toward which the base of the sphenoid bone moves. Displacement of the axis of the orbit due to rotation of the sphenoid bone relative to the occiput, distortion in the shape of the orbit due to medial pressure on the greater wing, and distortion of the superior orbital fissure due to the changed relation of greater and lesser wing result. Pathophysiologic influences on the structures passing through that fissure may be anticipated.

The temporal bone at birth is in two developmental parts, the petromastoid and the squama. The membranous attachments of the tentorium cerebelli relate the movement the petromastoid portion to the occipital bone posteromedially and the body of the

sphenoid anteromedially, while the squama is responsive to the greater wing of the sphenoid and parietal bones.

A lateral strain distorts the relation of the base of the occiput between the petrous portions. The squama of the temporal bone moves with the greater wing of the sphenoid. This results in production of an intraosseous lesion of the temporal bone in which the squama is carried anteromedially, and there is increased angulation of the petrous axis within the base. When the cranial base develops without strains, the axis of the petrous bone of one side makes a 90-degree angle with that of the opposite side. The intraosseous lesions of the temporal and the sphenoid bones are liable to disturb the third, fourth, and sixth cranial nerves and the ophthalmic division of the fifth, as well as to disturb the cavernous sinus and superior and inferior petrosal sinuses, which provide venous drainage from the orbit.

The occipital bone is in four parts at birth and is not fully united into a single bone until the child is about 6 years of age. Therefore during this period of vulnerability the occiput is four bones that surround the foramen magnum. Almost all the major nerve pathways from the brain to the body and from the body to the brain pass through the space contained within these four parts of the occiput. Furthermore, the twelfth nerve, motor to the tongue, passes between the condylar and the basilar portions. The ninth, tenth, and eleventh nerves pass out of the skull in close relation to this same intraosseous articulation. In an occipital presentation it is the occipital squama that must open the birth canal. Disproportion, asynclitism, rigidity of the cervix, or any other obstruction to the progressive symmetric descent of the head into the birth canal may cause an anterior compression to the basilar portion through the squama, via one or both condylar parts, and distort its relation to the body of the sphenoid bone. Symmetric compression may create a vertical strain; asymmetric force, a lateral strain. Furthermore, the cerebellar hemispheres occupy the inferior quadrants of the occipital squama, the occipital lobes, the superior quadrants. Distortion of the occipital squama so that the supraocciput is flat and rigid and the interparietal portion attenuated and pointed conceivably may influence the functional proficiency of the related areas of the brain which are involved with coordination, balance, and vision.

Such trauma not only distorts the cranial bowl. It may be transmitted by the dural membranes, the core link, from cranium to sacrum. Occipital distortion will be reflected in sacral malalignment. Furthermore, the various fascial planes take their origin from the base of the cranium. Cranial distortion frequently is associated with, fundamental to, and inseparably linked with vertebral scoliosis. The following case is illustrative:

Case 2. A girl aged 7½ years (Fig. 2A) was born with "a crooked head" and wryneck. She was slow in school, below average in most of her subjects, and had a volatile temper if she did not get her own way. Examination showed severe parallelogram distortion of the head due to right lateral strain of the sphenobasilar synchondrosis with superior vertical strain and compression. A compensatory scoliosis (Fig. 3A) was noted. The prognosis for such a severe congenital traumatic pattern in a child aged 7½ years was guarded, but a gratifying improvement in appearance and performance was noted after 7 months of weekly structural treatments (Figs. 2B, 3B).

It is important to reemphasize the rhythmic motion of the craniosacral mechanism.[12] Distortions of the anatomic form may impair, obstruct, or distort the physiologic function of the primary respiratory mechanism, which includes the inherent motility of the central nervous system and the fluctuant motion of the cerebrospinal fluid.

But again arises the compelling question: What happens during that "critical period" that relates this distortion of the craniosacral mechanism to the problems in learning that are manifested years later?

In the middle of the night I was awakened and called to attention to record the answer. Nerve pathways concerned with perception are complex and involve many connections with interrelated functions. Few of these have been established at the time of birth. Not only does structure influence function, but functional patterns mold developing structure. Precise geometric patterns are found within the healthy cranial mechanism. The axes of the orbits intersect above the posterior boundary of the sella turcica and may be projected into the con-

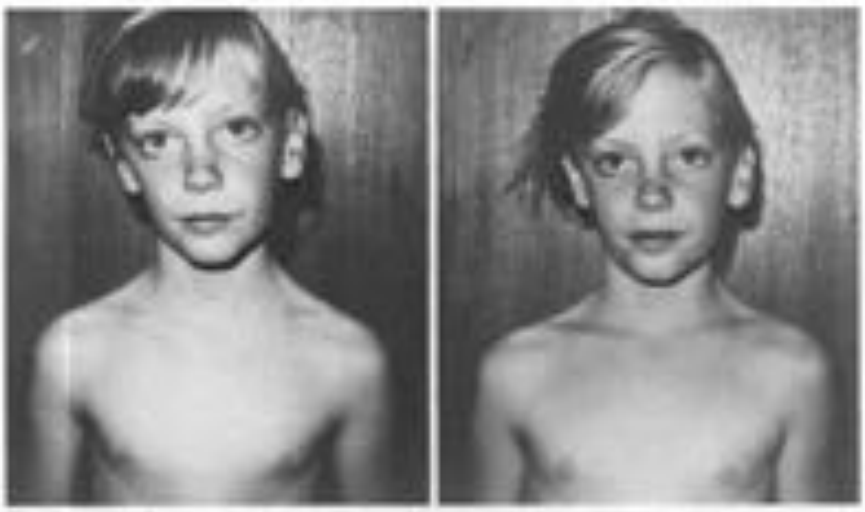

Fig. 2A. (Case 2). Seven-and-one-half-year-old girl on May 16, 1973, before treatment. Note the parallelogram deformity of the head, the left eye and the left ear superior to the right, and lateral flexion of the head to the right. Fig. 2B. After treatment on August 3, 1973.

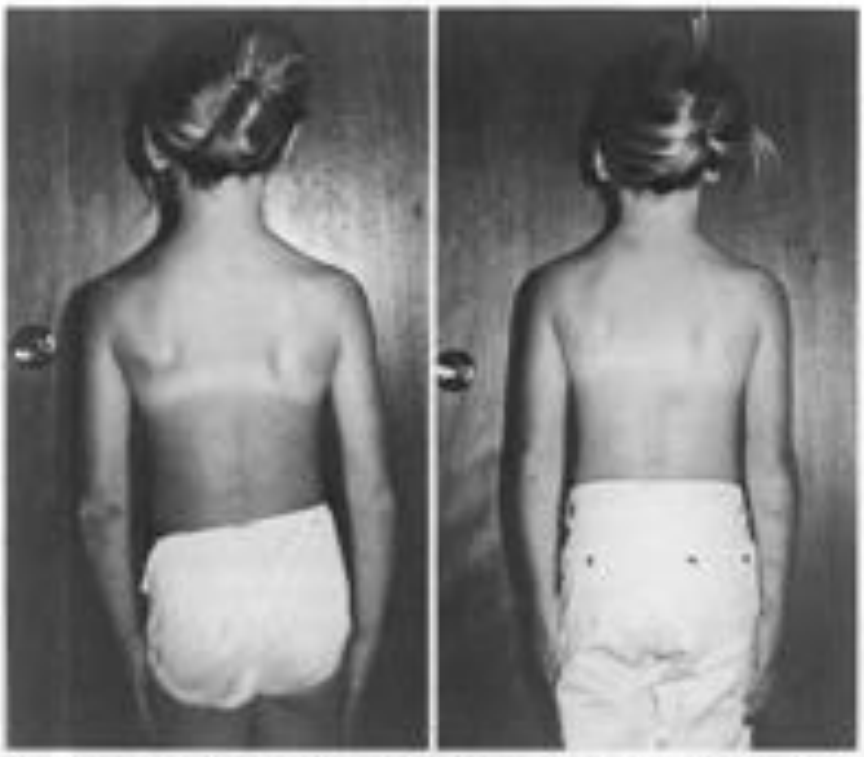

Fig. 3A. (Case 2). Back view before treatment, showing scoliosis (left thoracic concavity, right ilium superior, right scapula inferior). Fig. 3B. After treatment, the posture has improved.

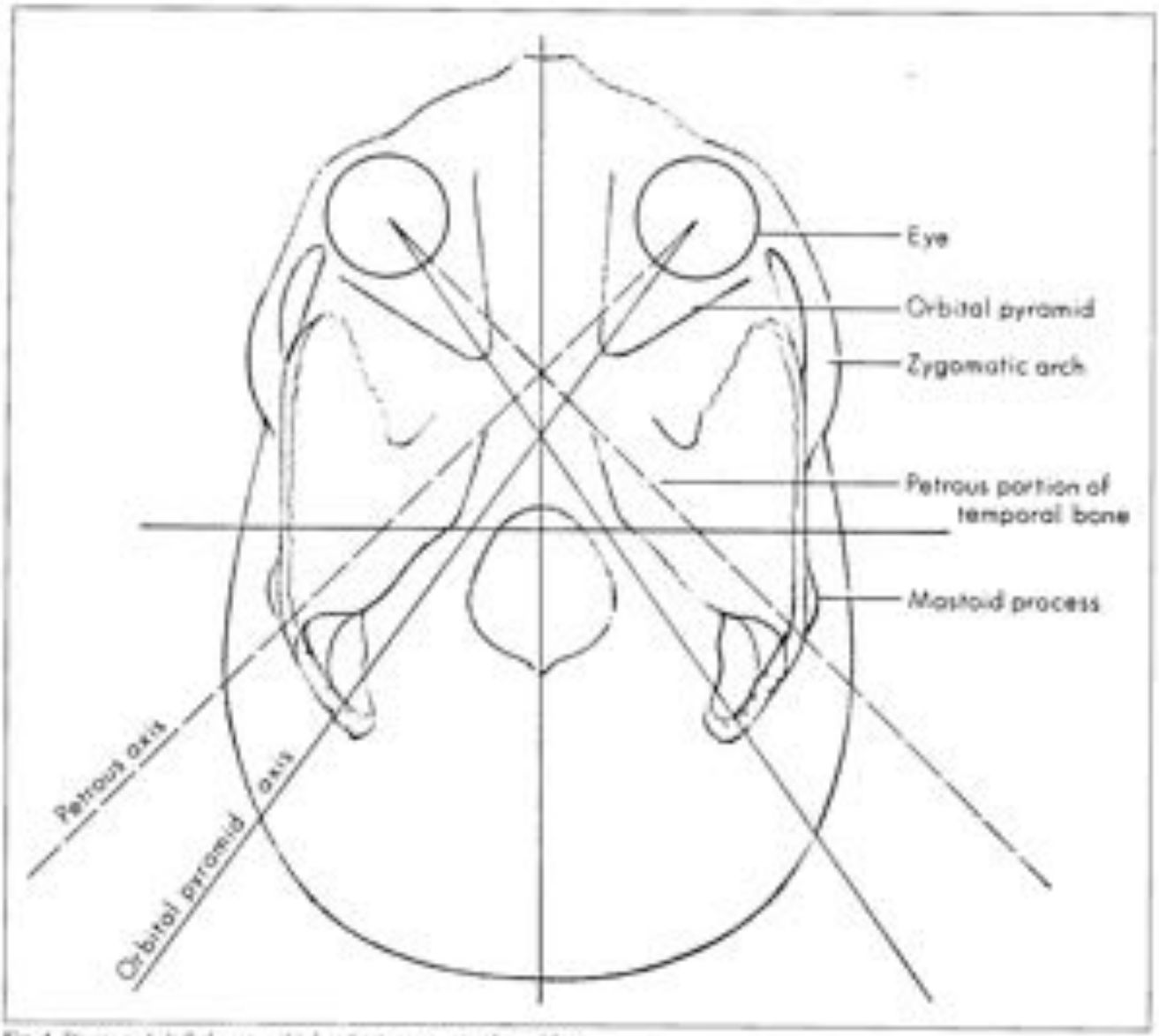

Fig. 4. Diagram of skull showing orbital and petrous axes in plane of base.

tralateral posterior cranial fossa above the tentorium cerebelli. The axes of the petrous portions of the temporal bones intersect within the sella turcica anterior to the intersection of the orbital axes and project into the body of the zygoma on the opposite side. These axes may be palpated as lines of force transmitted from one hand to the other. Their anomalous arrangement in a lateral strain pattern also is palpably distinctive.

Figure 4 depicts the orbital and petrous axes in the plane of the base of the skull in a hypothetical symmetric cranium.

Figure 5 depicts the symmetric orbital axes of a free cranial mechanism as they may be palpated between one hand placed over the orbit and the other holding the contralateral part of the occiput in the palm.

Figure 6 illustrates the distortion of the orbital axes in a right lateral sphenobasilar strain. The axis of the left orbit projects to the contralateral part of the occiput, but that from the right orbit is projected to a more medial location than this. In some instances it is found on the ipsilateral part of the occiput.

Figure 7 depicts the symmetric petrous axes between the external auditory meatus of one side and the body of the zygoma on the opposite cheek.

Figure 8 illustrates the distortion of the petrous axes in a right lateral sphenobasilar strain. The left petrous axis is palpated between a finger placed in the left external auditory meatus and the other hand on the body of the zygoma. The right petrous axis is palpated between the external auditory meatus on the right and a point on the zygomatic process of the

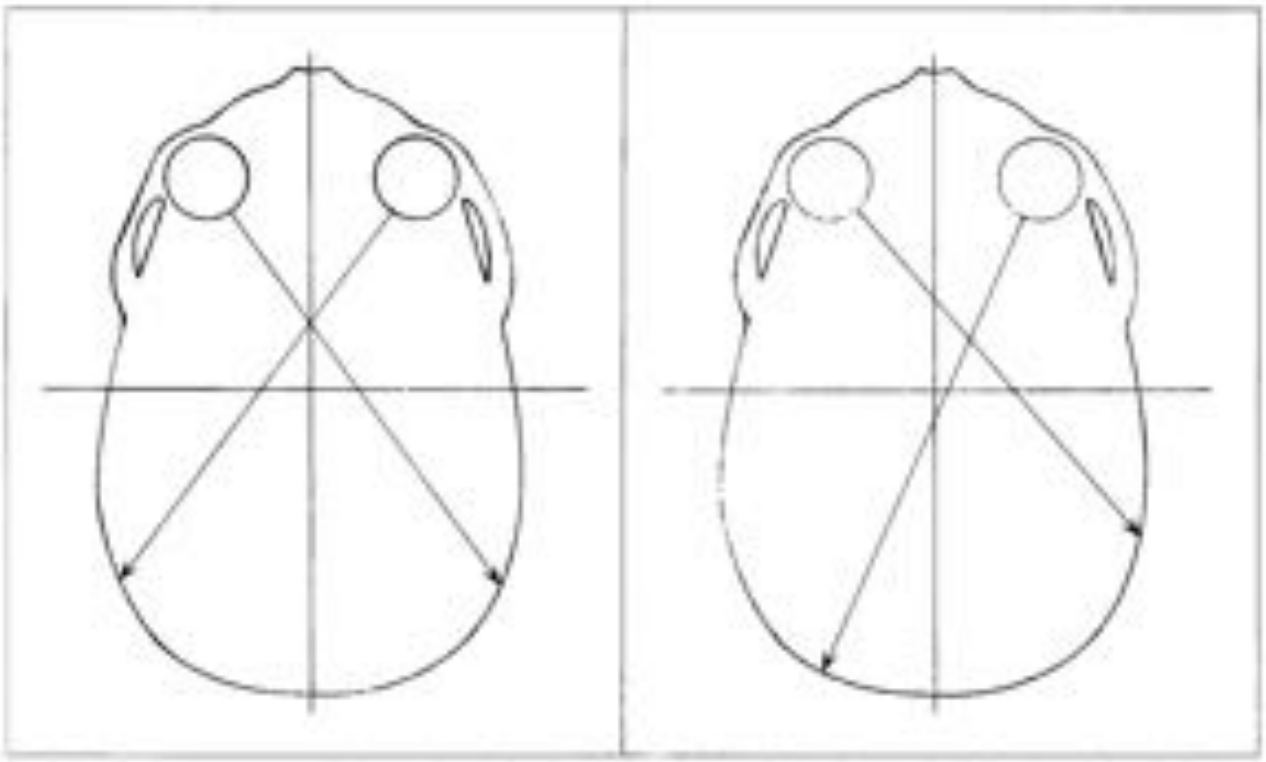

Fig. 5. *Diagram showing symmetrical orbital axes as they meet the fixation.* Fig. 6. *Diagram showing distortion of orbital axes in right lateral rectus palsy.*

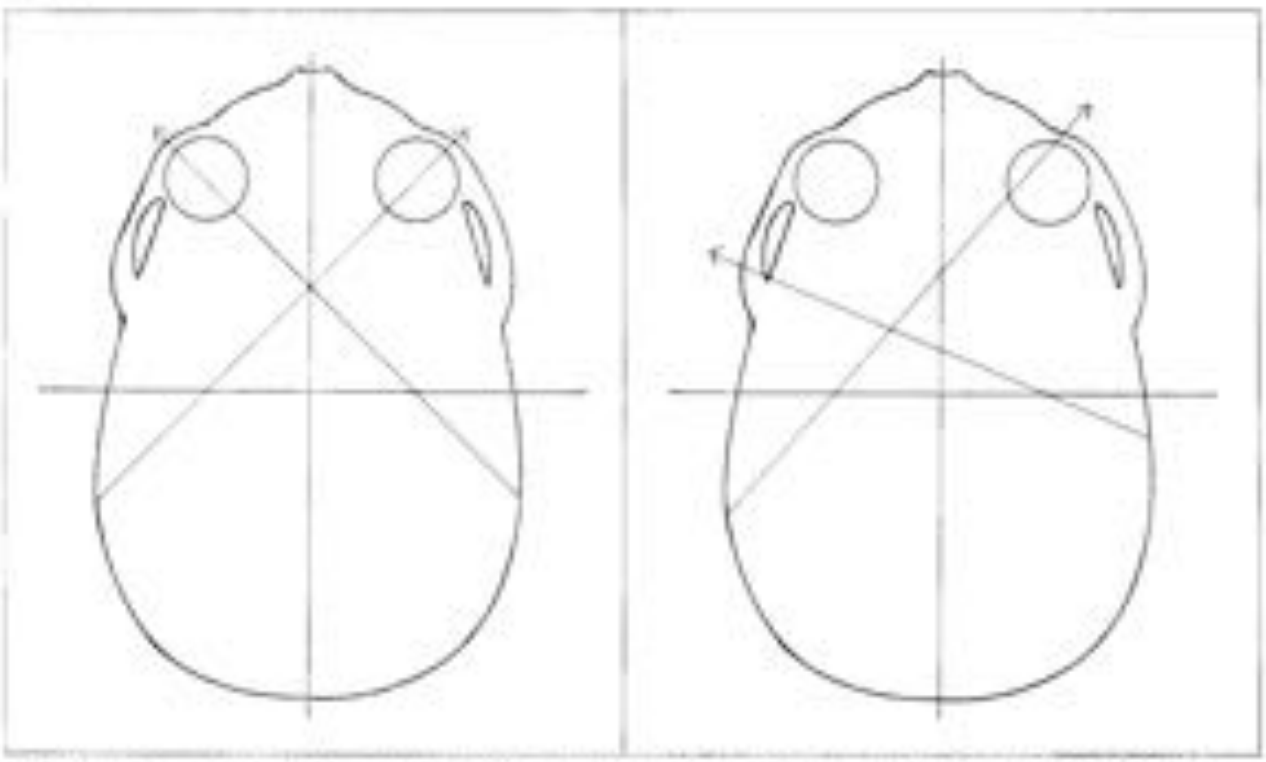

Fig. 7. *Diagram showing symmetrical palsy axes.* Fig. 8. *Diagram showing distortion of palsy axes in right lateral rectus palsy.*

left temporal bone. In many instances this point is just anterior to the opposite external auditory meatus.

Figure 9 shows a skull in which such distortion is visible and palpable.

The hypothesis derived from these clinical and anatomic observations is that the developing nerve pathways are laid down within these geometric forms. If these forms are distorted prior to completion of development of these nerve pathways, these too must develop with distortion, thus creating confusion in sensory input and causing poor coordination in motor activity. Thus the examination and treatment of the craniosacral mechanism of the newborn infant and its continued surveillance during the first 2 years of life assume a new significance and even greater importance than was formerly appreciated.

Must one, therefore, assume that it is too late to change significantly the course of events for the child of school age who is confronted with all the problems associated with learning disability? The results in cases 1 and 2 suggest that all is not lost even in children at the age of 12 years if the physician directs attention to the accessible musculoskeletal craniosacral strain pattern with the assurance that structure does govern function and that improvement in the structure and function within the primary respiratory mechanism will improve neurologic function and, therefore, intellectual performance. The following cases illustrate the possibilities:

Case 1. A girl 7 years of age (Fig. 10A) was the older of two siblings. Her birth had not been remarkable, but at the age of 6 months she fell off a swing onto the back of the head. Her father had had a problem in learning to read. She was a passive child, but sat up, crawled, walked, and talked at acceptable times. She could not work puzzles, she could not skip or hop and had great difficulty in learning to ride a bicycle. She suffered many falls in trying to roller skate. In kindergarten she cried because she could not cope. At the time of examination she still was highly emotional and cried at the least provocation. She was either very happy or depressed. She had a hard time following directions and daydreamed in school. She was fidgety and tense, and her attention span was short.

She was referred to me by an optometrist who already had given her two units of vision training, with improvement in her awareness of form and shape.

At the time of my initial examination, on April 18, 1972, her arm-leg coordination in walking was adequate. Her standing posture (Fig. 11A) exhibited a rotoscoliotic pattern, which was exaggerated when she stood on one foot. The ilium on the side of the lifted leg rotated posteriorly. There was lumbar lordosis. When she was supine, the base of the sacrum was elevated on the right. The sphenobasilar symphysis was in left torsion, right side-bending rotation. The right temporal bone was externally rotated. The occiput rocked slowly around an anteroposterior axis and was higher on the right than on the left side. The hard palate was high, externally rotated on the right and internally rotated on the left. These signs suggested several traumatic insults to the cranium.

By the end of the school year, after six weekly treatments to the total mechanism, she was reported to be much improved, calmer, more serene, with no need for summer school, and was scheduled to go into a special class for gifted children in September (Figs. 11B, 11B). The optometrist[17] supplied the following evaluation:

"The child had completed two units of vision therapy before referral to Dr. Frymann. She was still unable to perform certain visual motor tasks, and her posture did not respond to training. She had normal visual acuity and muscle balance findings at distance. Fusional reserves at the near point were low, and it was not possible to get bino fide responses on other near point tests.

"After completion of the osteopathic treatment all signs of visual acuity, muscle balance, and fusional reserve were normal at both distance and near point. She had learned to twirl a baton and jump rope. Her body awareness and body image had improved, and spatial awareness was more alert."

Case 2. A boy aged 8½ years was the third of six children. His birth weight had been 3.56 kg., but no difficulties were recalled. He never had crawled. He walked at the age of 9½ months. He had fallen out of his crib at age 15 months. His eyes were dilated, and he was very quiet. In first grade, he "did not do well." He was repeating second grade at the time of examination and did not show any interest in reading. He did not like to go to school and was highly self-conscious.

Examination showed him to be tall and slender with a frightened, depressed demeanor. When he was erect, the right ilium was elevated, the right shoulder elevated and anterior, and the right ear posterior and slightly inferior to the left. When he was supine the sacrum was elevated on the left, and the sphenobasilar mechanism was in right lateral strain with left torsion. The right temporal bone was internally rotated. The occipital sphere of the head was restricted in physiologic motion. As treatment progressed, an underlying superior vertical strain of the sphenobasilar symphysis was revealed.

By the seventh week of treatment the school noted a marked change in his attitude and performance. He was a happier, more communicative boy. By the end of the second grade, 8 months

later, his reading was reported to be progressing well and his study habits improved. He was much happier than he had been.

At the time of this report he was in eighth grade and attaining better than average grades.

Case 5. A 9-year-old boy with an I.Q. in the exceptional range had a short attention span, and it was recommended that he repeat third grade.

Early in pregnancy his mother had been threatened with miscarriage. He was born 6 weeks prematurely. He had difficulty in breathing immediately, a continual problem with phlegm during the first year of his life, and asthma up to the age of 7½ years. In school he could not sit still, made no effort to do his work, and copied at half the speed expected at this age.

His developmental landmarks were within normal limits, and he could roller skate and ride a bicycle satisfactorily. As a small baby he had fallen on the back of the head.

At examination he was unable to stand still, and the level of the ilia, the shoulders, and the ears was slowly changing all the time. In a walking test he was unable to coordinate arms and legs. When standing he could not swing his arms in a smooth alternating rhythm.

Balancing on one leg was poor. There was no hip drop on the side of the flexed hip.

When he was supine, the sacrum was superior on the left and posterior on the right. He was dolichocephalic, his head of excessive type. The sphenobasilar symphysis exhibited a superior vertical strain, a right lateral strain, and compression. The left temporal bone was fixed in internal rotation. The hard palate was high and internally rotated bilaterally.

On account of his inadequacy for promotion into fourth grade, it was deemed advisable to give him perceptual training during the summer months concurrently with osteopathic care. As a rule these two procedures are arranged sequentially in order to evaluate the specific contribution of each. By the second month of fourth grade, after seven osteopathic treatments and a 6-week interval without treatment, he was reported to be able to sit still and read and his writing was "drastically improved, and uniform in size." He was up to sixth grade in standard achievement. The unaided visual acuity had improved from 20/40 to 20/30 in each eye individually and in both together.

Comment

The diagnosis of a learning difficulty is easy to make if routine history taking includes questions about academic achievement and school performance. Determining the factors that cause or contribute to the learning problem is difficult. In general a battery of such tests as were used in the evaluation of children with learning and behavior problems by Johnson[19] shows associated psychologic and physical inadequacies that stem from the same etiologic roots and interact with the academic problem to produce the unhappy state. Occasionally a specific problem such as impairment of vision or hearing or petit mal episodes may be revealed, and correction of this produces an immediate and happy solution. But such cases are the exception.

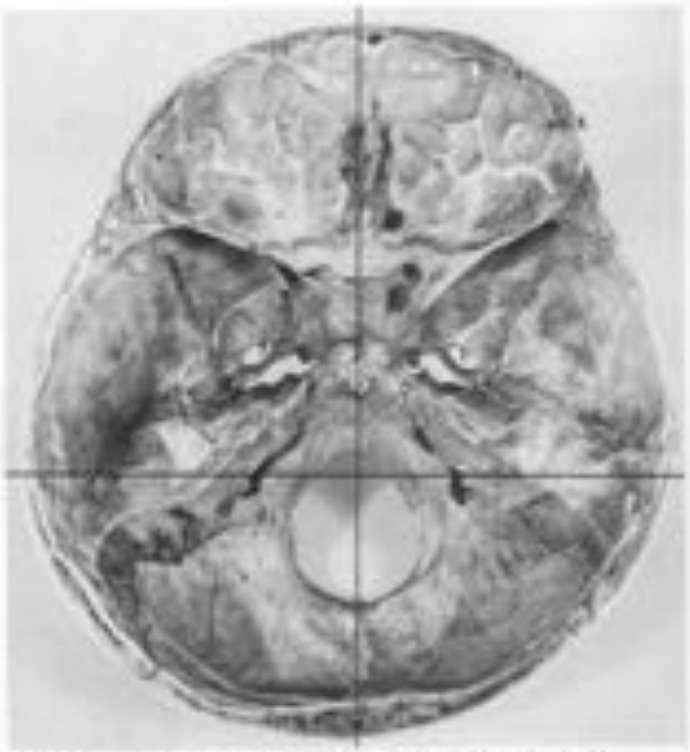

Fig. 9.—*Photograph of skull in which distortion is visible and palpable.*

The purpose of my project, in obedience to the admonition of Still, was to search for the causes.

I begin by interviewing one parent, preferably the mother, alone. It is a sound rule never to discuss a child in his presence. Conversation with one parent will provide an opportunity to learn much about the home situation that would not be exposed in the presence of the spouse. A thorough history of pregnancy, birth, early development, childhood behavior, interests, and skills will provide indications of inadequacies in the development of those visual circuits that precede scholastic experiences. Inquiry should be made concerning trauma, high fevers, or serious illnesses. Questions concerning academic achievement, attitude toward school, and relations with peers may evoke a profound unburdening of concern and anxiety by a parent regarding an educational problem for which he or she has been unable to find a solution.

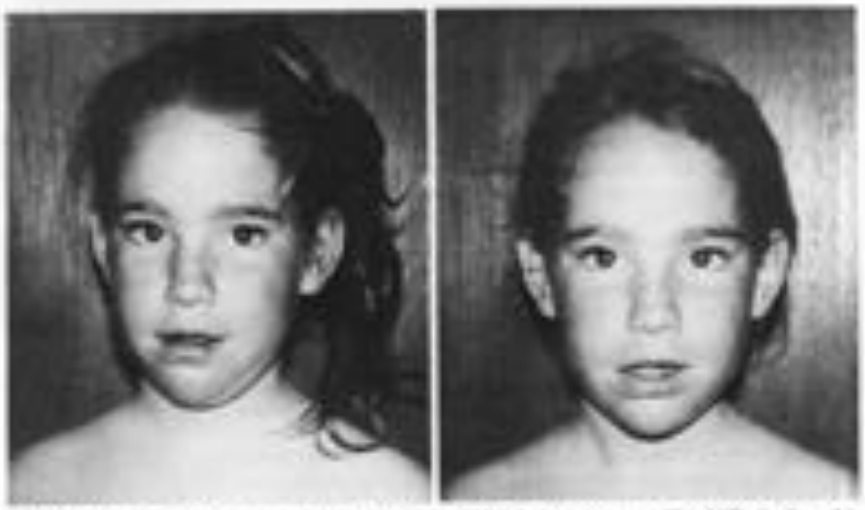

Fig. 10A *(Case 3). Seven-year-old girl on April 19, 1972, before treatment.* Fig. 10B *On June 14, 1972, after treatment. Note improved centralization of head on body and eyes in forward-looking position.*

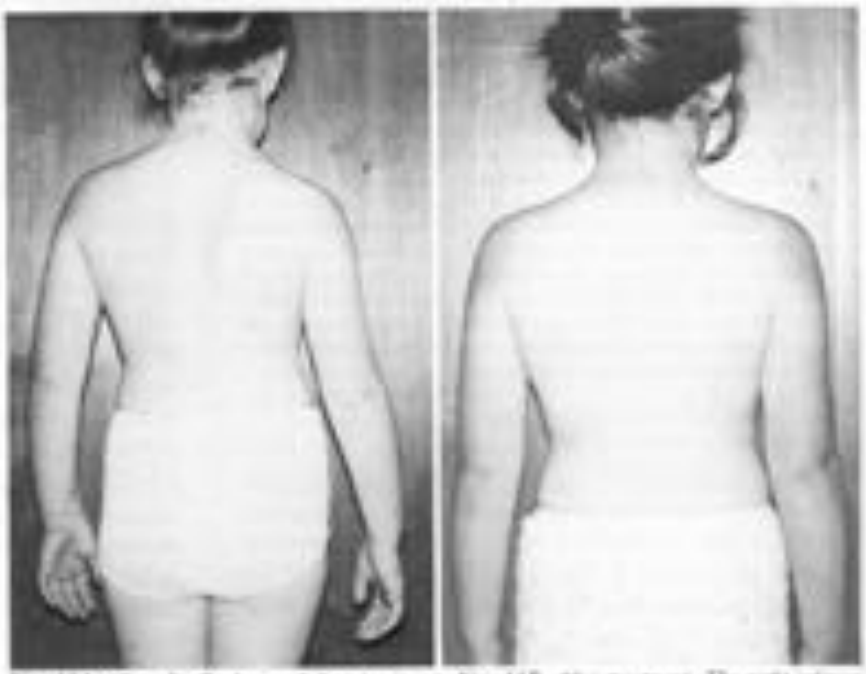

Fig. 11A *(Case 3). Back view before treatment.* Fig. 11B. *After treatment. The right inferior shoulder is level with the left. The scoliosis has improved.*

port were referred to me by an optometrist who, in an association of 20 years, has come to recognize the contribution of osteopathic care in the therapeutic program of children with learning problems.

The examination of the child always is made without the presence of the parents. First photographs are taken. A few simple tests incorporated into the physical examination will contribute to the diagnosis. Among these are tests of rhythmic alternating swinging of the arms and arm-leg coordination as in marching. In another test the child is directed to look in a kaleidoscope, during which he will use the dominant eye. He is asked to demonstrate how he uses a fork or pen, for which he will use the dominant arm. If he is asked to pretend he is kicking a ball, he will use the dominant leg. Crossed dominance is an important observation, which may have significance in relation to other findings.

In other tests the child is asked to watch the physician's finger without moving his head as it is passed from left to right in front of him. The physician notes whether the child blinks his eyes or whether the eyes jerk as they cross the midline. Inability to control the eyes may interfere with scanning a line of print. A similar test is made of eye motion through all diameters, vertical and diagonal. Also, the child is directed to focus attention on the physician's face and the physician notes whether the child uses one eye or two. The child is asked whether the physician's nose has a shadow.

If several of these tests show abnormality and there is a history of underachievement in school, the child should be referred for a thorough evaluation of perceptual function by an optometric graduate of the specialty College of Vision Development.

At the first visit the physical examination is completed, with structural evaluation of the whole musculoskeletal system, the craniosacral mechanism, and dental alignment. The findings are recorded. A diagnostic and prognostic assessment is made.

A conference with both parents, without the child, follows. The findings are explained. If further tests are indicated, these are explained. The prognosis must then be considered. As a general rule the younger the child is, the better the prognosis. For an adolescent, in junior or senior high school, the limitations on possible improvement are emphasized, but it is pointed out that by improving some of the accessible factors in the problem, the whole body pattern will change and permit the child to make the best use of his faculties. For most parents any improvement is better than none.

From long experience it has been learned that significant changes in the anatomic physiologic mechanism will take from 6 to 8 weeks of weekly visits to become demonstrable to parents and child. This should be explained to the parents before treatment begins. No evaluation of progress will be made during that period. If parents or child notice changes before that time, that is a dividend. If they do not, that time interval is the physician's protection. On the last scheduled visit, progress and future plans are discussed with the parents, and photographs are taken again.

If visual training is needed, it usually takes place after the intensive osteopathic treatment is completed.

The value of perceptual training is a subject of considerable controversy.[9] Perhaps the same might be said of osteopathic care. But the relation of the osteopathic physician and the optometrist in the care of the child with learning disability might be compared to the relation of the piano tuner and the music teacher to the young musician.

No matter how skilled the music teacher or how talented the child may be, that child never will create harmonious, melodious music if the piano is out of tune. After the tuner is called in to adjust and tune the instrument, the teacher may be invited to train the child to use it. The osteopathic physician is skilled in adjusting and tuning the instrument. After this is accomplished, the vision specialist should be permitted to correct bad habits and teach the child improved ways of efficiently using his faculties.

Conclusion

This study, with all its limitations and inadequacies, has demonstrated the need for a 10-year research project to determine if the diagnosis and treatment of craniosacral strains resulting from perinatal stress, and the periodic reevaluation of the child during his formative years to reverse any strain patterns resulting from trauma will reduce the incidence of learning difficulties. It has provoked new questions on the relation of the geometric patterns of the body and its neurologic function.

It has demonstrated that the whole range of traumatic patterns may be found in children with learning problems as well as in children who do not have a learning disability.

It has demonstrated that there is a critical period of susceptibility when strain patterns contribute to the learning disability, and that this critical period, up to 2 years of life, is the period of opportunity for the optimum benefit from the correction of such strains.

It has demonstrated also that many children may be benefited by osteopathic diagnosis and treatment of the total body, including the craniosacral mechanism, long after the critical age of 2 years, but in general the results will be better for the child in elementary school, particularly in the lower grades, than for the student who already has reached junior high school. By that time the disillusionment with school, the repeated failures in academic achievement, and all the psychologic stress superimposed on the perceptual dysfunction and the incoordination within his being make rehabilitation slow and incomplete.

Nevertheless, if a treatment program can be developed to enable the patient to function at maximum capacity, accept himself, and recognize all the assets that can offset many of the limitations, the time and the effort are well worthwhile.

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