The factors that cause a vertebral subluxation complex in children warrant our exploration and investigation. When does the first subluxation occur? Does the possibility of preventing or eliminating the impact of vertebral subluxation exist? These questions and hypotheses should be posed by Doctors of Chiropractic and the supporting research community. This chapter discusses the role of chiropractic care in children. Because many spinal abnormalities can be due to in-utero factors, the care of the pregnant patient is also presented.

In the mature spine, skeletal structure primarily dictates function, particularly joint movement. For the developing spine, the functional demands drive the formation of bones and joints. Hippocrates noted that individual constraint caused physical alterations, because they altered normal function (1,2). A constraint position held over a sufficient period of time can influence the outcome of physical form (1,2). These physical alterations can then lead to abnormal function.

DEVELOPMENTAL AND INJURY MECHANISMS

The morphogenesis of bone, cartilage, ligament, and muscle are influenced by biomechanical forces. The human fetus will develop seven times more quickly than the infant. Because of this rapid growth, the fetus is most sensitive to biomechanical forces that lead to constraining pressures and molding (2,3). There are two factors that can alter morphogenesis: intrinsic and extrinsic. Intrinsic hormonal and biomechanical mechanisms can influence the genetically predetermined shape of bone. The physical properties that contribute to internal resistance and deformation of bone are fatigue strength, elasticity, energy absorbing capacity, and density (2). The bone elasticity is subjected to the forces of shearing, compression, bending, torsion, and stretching (2). Other factors such as nutrition can also affect the growth of bone.

Suppression of longitudinal growth also may occur from excessive compression forces that are placed on the perpendicular growth plates (2). Unequal compression loading and stretching of a growth plate can alter deposition of bone thus leading to asymmetry of the osseous elements.

An abnormal position occurs when the fetus does not move into the vertex position at the 7th month. In-utero constraint is the most common cause of extrinsic deformation. Approximately 2% of babies are born with deformities because of extrinsic factors (1-3). The growth plate is also susceptible to torsional forces that may cause rotational alterations (2,4). Extrinsic forces that influence the musculoskeletal systems include: gravity (abnormal weight bearing affecting the force on bone), strong muscles producing tensile loading, and dynamic stressors (2). The forces of shearing, stretching, compression, torsion, and bending are all extrinsic factors which can alter the growth and shape of the musculoskeletal system.

In-Utero Constraint

Various causes of in-utero constraint include: primigravida (i.e., excessive abdominal wall strength); small mother; uterine malformation; and fibromata (2). Four positions of the fetus that can cause biomechanical compromise to the spine are: breech, face, brow, and transverse presentations.

The last trimester of gestation, when the growth of the fetus fills the uterine cavity, is the most likely time for constraint to occur. This fact is supported by evidence of therapeutically aborted fetuses of 20 weeks or less revealing no observable deformations (1).

Abnormal positions of the mother’s uterus from alterations in ligament attachments could lead to asymmetrical forces on the fetus. These abnormal ligamentous changes can result from abnormal position or movements of the lumbar spine and pelvis. Changes in the position of the lumbar spine and pelvis may also play a role in the development of in-utero constraint.

Breech or cephalic presentations occur in approximately 4% of all pregnancies and account for 32% of extrinsic deformations of the fetus (1). There are three forms of breech: frank, complete, and footling (Fig. 14.1). In approximately 70% of breech presentations, the fetal
movement is restricted by abnormal positioning of the legs (Fig. 14.2). The fetal position with legs extended in front of the fetus' abdomen is considered the cause of the fetus "catching" itself in the (breech) cephalic presentation.

Dunn (3) reviewed 6,000 cases of breech babies and found that 42% had postural scoliosis and that 20 to 25% had such deformities as torticollis, mandibular asymmetry and talipes equinovarus. Approximately 50% of breech infants will have hip dislocation (3).

The breech position places the head and cervical spine into a hyperextended position. The breech position pushes the cranium posterior and can either hyperextend or hyperflex the cervical spine—depending on the position of the chin (1,2). Breech positioning also can compromise the cervical, thoracic, lumbo-sacral and pelvic regions (2). Birth complications often arise because of the breech position.

Transverse lie positioning is seen in 1 of every 300 to 600 deliveries and is more common in multiparous females (1). Pressure against the lateral border of the uterus causes posterior displacement of the head and hyperextension or hyperflexion of the upper cervical spine (Fig. 14.3). The anterior compression of the cranium may force the occiput into a posterior superior (PS) subluxation. Transverse lie can lead to other postural deformities such as scoliosis (1); therefore, the entire spinal column should be examined after delivery.

Face presentation occurs approximately in 1 out of every 500 births. Brow presentation (Fig. 14.4) is even less common (1). Here, the face is compressed and the head and neck are forced into hyperextension. Both face and brow presentation have the potential of causing upper cervical subluxation, such as an anterior superior (AS) occiput.

Currently, two procedures that are used to treat the
breech fetus are: external manipulation (with associated high risk for complication) and cesarean surgery which can also lead to complications (1). Smith hopes that the future will hold new alternatives to the prevention and resolution of the breech presentation.

An alternative to the previously described approaches has been developed by Webster (5) (See In-Utero Constraint Turning Technique).

Chiropractic pre-natal care may be the first opportunity to reduce morphogenic changes from extrinsic factors. This may prevent or reduce the development of the vertebral subluxation complex and other associated biomechanical alterations.

Birth Trauma

The birth process can be another potential source of trauma to the spine which may lead to neuropathophysiological effects. The cause of trauma in most instances is due to a forceful tractioning of the spine while in a hyper-extended position. Longitudinal traction with rotation and flexion, or excessive lateral bending, also can cause injury (Fig. 14.5) (1,3,5–9). Towbin (9) found that mechanical injury from delivery procedures could produce cord compression and vertebral subluxation. These abnormalities may escape detection with standard radiographic methods because of the elastic properties of the pediatric spine.

Cesarian, forceps, (Fig.14.6) and suction or vacuum extraction (Fig.14.7) deliveries also can cause trauma to

Figure 14.5. Delivery of the newborn. Upward traction on the head is used to deliver a posterior shoulder over the perineum. Modified from Wilson JR, Beecham CT, Forman I, Carrington ER, eds. Obstetrics and gynecology. St. Louis: CV Mosby, 1958:336.

the cervical and thoracic spine. The hand dominance of the obstetrician may lead to specific (left or right sided) cervical rotatory trauma. Approximately 70% of the general population have right handed dominance (10).

The complications of a vaginally delivered breech fetus, include both spinal and neurologic trauma (7). The delivery techniques are known to cause brachial plexus and cervico-thoracic nerve root damage (e.g., Erb’s Palsy and Klumpe’s paralysis) and potential upper spinal cord transactional lesion in severe cases. Approximately 24% of cerebral palsy cases could be caused by or attributed to delivery techniques for the breech fetus (1).

Gutmann’s review of 1,000 infants (11) suggested that birth trauma often affected the atlanto-occipital joint resulting in blockage or vertebral subluxation. These abnormalities could alter peripheral nerve or brain stem function. Gutmann further speculates that abnormal nerve function may lead to lowered resistance and thus predisposition to disease.

Sudden Infant Death Syndrome (SIDS) appears to be related in some instances to birth trauma. Any process, whether genetic, biochemical, biomechanical or traumatic, which alters normal development and function of the respiratory control centers may cause this syndrome (12).

Post Natal Development of Spinal Asymmetry

The spine is composed of cartilaginous material up to the age of six. It is, therefore, readily susceptible to morphogenetic alterations during this period (1,2,13,14). The average length of the spine (excluding the sacrum) of the newborn is approximately 20 cm. Within the first two years of life the length of the spine will grow to approximately 45 cm (13).

At birth, the infant’s vertebrae consist of the centrum and the two halves of the neural arch. Uniting all parts is hyaline cartilage. A cartilaginous spine does not contraindicate carefully applied specific adjustments. Posterior synchondrosis (uniting of the vertebral arches) normally occurs first. The closure begins at C1 during the first year, and the process is completed by approximately the eighth year at the lumbar spine. Neurocentral synchondrosis (centrum ossification) is completed at approximately the third through the fifth year in the lumbar spine and by the fifth through the eighth year in the cervical spine. The sacrum and ilia do not completely ossify until the third decade of life.

Bone development is influenced by nerve and circulatory factors that control chemical and cytologic function (14). The shaping of bone and the joint surfaces depends on whole body motion. Motion restriction will lead to developmental asymmetries. Because the transitional areas (e.g., C0-C1, L5-S1) of the spine are more susceptible to biomechanical stresses, these regions are often affected more when asymmetrical loads or abnormal movements are encountered (14,15) (See Chapter 2).

For example, the infant or toddler learning to master the muscular coordination for standing or walking will have numerous falls to the sitting position. Pure symmetry and balanced movements unfortunately do not exist for the infant, toddler, pre-adolescent, or adolescent as they progress through their developmental stages. Micro and macro trauma, unilateral activities and sports, as well as postural and repetitive habits, are all considered a part of the normal childhood (6,13,14–17).

Jirout (17) has investigated the relationship of left-right hand dominance on the structure of the spine. In a radiographic study limited to the upper torso, 94% of the 600 human subjects demonstrated left-right positional asymmetries. The more prevalent right-handed dominance caused significant muscular imbalance, sufficient to shift the occiput and spinous processes of the involved vertebrae toward the right side. Another study of 100 subjects (17) confirmed right-handed dominance with right compensatory shift of the occiput and cervical region. In this report, left-handed exercises were given to right-hand dominant subjects. This resulted in a temporary shift of the spine to the left side.

The influence of hand dominance on idiopathic scoliosis has been studied by Goldberg and Dowling (18). Left-handed dominance was associated with a left convex scoliosis in the lower thoracic region. Right-handed individuals tended to develop right convex curves (See Chapter 9).

In a large radiographic study it was concluded that the atlas vertebra was asymmetrical in 99% of the cases. The report by Anderson (10) on 156 archaeological crania (comprised of Californian, Peruvian and Egyptian specimens), basioccipital angulation occurred in nearly 60% of
the cases. He further states that right-handed dominance could influence the cervical spine with persistent tension at the left-sided musculature, thus resulting in structural deviation.

The influence of intrinsic (e.g., genetic) and extrinsic factors on the developing spine is well documented. The role of chiropractic care in ameliorating or preventing developmental spinal abnormalities is not well understood and merits further research.

**Childhood Injuries**

**MOTOR VEHICLE INJURIES**

In the United States the leading cause of death under the age of 25 is accidents (6). The leading cause of accidental deaths from the ages of 1 to 25 years is automobile related. Younger children tend to have more severe injuries. The head, neck, and facial region are the most frequently injured areas, although the whole body is also at risk (19,20). Two factors that increase the chance of injuries to younger children are the lack of or improper use of car restraints (e.g., car seats, seatbelts), and the presence of a larger head in relation to the upper torso. Underdeveloped cervical musculature may also contribute to increased forces sustained during impact. Glauser and Caes (19,20) discovered that during a collision, a child in a lap belt will elongate, jack-knife, and strike the back of the seat or dashboard.

The unrestrained child is most likely to receive the severest injury and die during an automobile accident. In a collision of 30 mph, it has been estimated that an unrestrained infant weighing 8 kg will accelerate and create the force of 350 kg. This is equal to the force generated by a fall from a third floor (6).

When hyperextension and hyperflexion trauma occurs, spinal traction, and cord compression or impingement can occur. Injuries from motor vehicle accidents are similar to those seen during birth trauma. Spinal cord injuries commonly occur at the lower cervical and upper thoracic region. The susceptibility of the spinal cord is increased in the midsacral region because of the enlargement for the brachial plexus at this area (19–21).

Melzak (21), Glauser (19), and Taylor (20) studied children involved in automobile accidents that resulted in traumatic paralysis. With rare exception, the radiographic evaluation revealed no fracture or dislocation; however, extensive spinal cord damage was present, resulting in the paralysis.

Although seatbelts and seat restraints can undoubtedly reduce the severity of injuries to children involved in motor vehicle accidents, they cannot completely eliminate traumatic acceleration/deceleration forces from impacting the child (6,19,20,22,23).

Vertebral subluxation with its associated components can occur from automobile accidents. The initial radiographic findings may only show slight alterations, however.

**OTHER INJURIES**

The home is the primary site for 2- to 3-year-old children to receive injuries. For 5- to 18-year-old children, school is the most frequent place for accidents to occur (6). Physical education, sports (See Chapter 2), and unorganized activities play a role in the occurrence of these injuries.

Bicycles are another childhood source of trauma. Over 50,000 children a year are treated for severe head trauma resulting from not wearing helmets while riding (24).

Playground equipment is responsible for 118,000 injuries a year to children. The majority of these accidents will be falls, 50% of which result in head and neck trauma (6).

Sudden hyperflexion or hyperextension of the neck, or vertical compression of the head or buttocks from falls, can cause either spine or spinal cord injury (16). Activities that are commonly associated with falls are skateboarding, roller-skating, horseback riding, surfing, water slides, or diving into shallow water.

Physically abused infants can sustain injuries to the spinal cord due to violent shaking of the head (16,22,23). An infant also can potentially fall from a high place (e.g., couch, bed) if left unattended. This could occur during routine diaper changing. In a study conducted by the National Safety Council, of 536 infants (25), 255 (47.5%) were discovered to have fallen head first from a high place (e.g., dressing table, bed) during their first year of life. Percy (26) reports that falls from a high place are not uncommon with young children and may cause rotational subluxation of the atlas and soft tissue damage of the cervical spine.

Maigre (25) reports that head and cervical trauma could create irritation to the cervical sympathetic fibers and may cause a variety of dysfunctional states: vasomotor and secretory problems; headaches; auditory, vestibular and visual problems; pharyngolaryngeal; and psychic disturbances. He reports positive results with these disorders when cervical adjustments are performed.

Goldthwait and Coe (23) theorized that faulty body mechanisms could alter the development of bone, eventually leading to adult functional disorders. Hinwood and Hinwood (25) report on a study of children under the age of eight. Although all subjects were considered “healthy” by conventional methods, nearly 40% had evidence of spinal subluxation.

**Implications of Pediatric Vertebral Subluxation Complex**

Lewit (15) discusses the possible ramifications of blockage (vertebral subluxation complex) if left uncorrected in the
child. The consequences of vertebral subluxation may appear insignificant, with the exception of occasional transitory pain. If the vertebral subluxation is left uncorrected, compensatory reactions would develop at adjacent motion segments, further masking the effects of the original lesion. Long-term biomechanical strain deprives the disc tissue of needed nutrition, eventually leading to internal reabsorption and degeneration. Degenerative changes at the vertebra include traction osteophytes and spondylophytic ridges. Both hypomobile and hypermobile segments will undergo degeneration.

Heilig (14) points out that the longer the period of osseous development during which asymmetrical forces are acting, the greater the frequency, duration, and extent of spinal damage. If abnormal spinal function could be recognized and ameliorated early on, the greater the opportunity for normal developmental patterns to be established (14). Heilig implores his colleagues to consider osteopathic care for children because developmental changes can be most easily effected at an early age.

If accidents are the leading cause of death and severe injuries to children in the United States, one could postulate that such injuries, even those of lesser magnitude, are a potential cause of vertebral subluxation(s).

NEUROLOGIC EXAMINATION OF THE NEONATE AND INFANT

The neurologic examination is a series of tests that assist the chiropractor in assessing the subcortical function of the newborn (0–4 months) or infant (4–12 months).

The newborn and infant examination can sometimes be challenging because of the lack of verbal communication. The examination presented here is considered supplementary to the usual neurologic spinal examination for adults and should be performed when indicated. Neurologic reflexes are used to evaluate the brainstem and spinal cord function.

Most newborn reflexes are present at birth or shortly thereafter. There are a few reflexes, however, that will manifest themselves from the 6th week up to the 24th month. If a reflex is absent, it may reflect general depression of motor function at a central or peripheral level. If asymmetry should occur in a reflex, this can indicate a central or peripheral focal motor lesion. For the normally maturing infant, the newborn reflexes will be replaced later by voluntary motor function. If a present finding persists beyond the normal age of disappearance, this may indicate a central motor lesion or a generalized developmental lag.

Note that although a doctor may expect a normal newborn/infant reflex, a recently fed or sleepy baby may manifest a depressed or brisk response.

Deep tendon reflexes (e.g., triceps, biceps, brachioradialis, patellar, and achilles) may be similarly elicited in the infant as in the adult. Rather than using a reflex hammer, the examiner should use a finger to tap directly the striking point or nailbed of the doctor (Fig. 14.8). The spinal reflex mechanisms (deep tendon reflexes and plantar response) may vary in response because of the lack of corticospinal pathway development in the infant. It is recommended that the doctor avoid labeling an abnormal reflex initially. Rather, the infant should be retested before concluding that there is indeed an abnormality.

A normal response of a deep tendon reflex is a brisk jerk. A cerebral disorder may be present if spontaneous clonus occurs with the feet, legs, and arms. Infants manifesting absence of reflexes also may suggest a neuromuscular disorder is present. The triceps reflex will not be present until after the 6th month.

Many authorities suggest that Babinski’s sign is not a reliable test before the second year of life. The examiner may elicit a positive sign of extension of the toes or a negative sign of toe flexion.

The cranial nerves also can be tested in the newborn and infant. The same procedures for the adult are adapted to the infant. Two cranial nerve tests that are more difficult to assess in the infant are Cranial Nerve II (optic) and Cranial Nerve VII (vestibulocochlear), specifically the acoustic portion.

Infant Reflexes

ROOTING

The examiner strokes with a finger the cheek of the newborn unilaterally. Begin slightly above the mandible and
glide toward the mouth. The normal response of the infant will be to move toward the stimulus. The response of the mouth is called “rooting.” This test should be performed bilaterally (Fig. 14.9). This reflex, which is present after birth, will disappear during the waking hours after the 3rd to 4th month. The rooting reflex can usually be elicited during sleep in infants up to the 7th month. Absence of this reflex, particularly before the 4th month, indicates a severe generalized, central nervous system disorder.

SUCKING

The examiner inserts the first phalange of a clean finger into the newborn’s mouth. The normal response should be a hearty “sucking” onto the finger (Fig. 14.10). This reflex is present after birth and continues to the 3rd or 4th month. Absence of this reflex may indicate a severe, generalized central nervous system disorder.

BLINK

The examiner shines a bright penlight into the newborn/infant’s eyes. The newborn/infant with a normal response will blink the eyes tightly shut (Fig. 14.11). This reflex should be present from birth through the first year of life. Absence of this response may indicate blindness.

ACOUSTIC BLINK

This reflex is sometimes referred to as the cochleopalpebral test. The examiner claps the hands very close to the newborn/infant’s ears. The normal response should be a bilateral eye blink to the loud noise (Fig. 14.12). This reflex is present from birth and has a variable time for disappearance. Absence of this response may indicate decreased or loss of hearing.

MORO

This test is commonly called the “startle” reflex. The examiner creates a loud abrupt noise or change in the newborn’s head position. The initial phase of Moro’s response is a symmetric abduction and extension of the arms accompanied by extension of the trunk. The second phase includes adduction of the arms. The legs will be active, although to a lesser extent than the arms. This response is present from birth through approximately the 3rd month. If this response persists beyond this period, it

![Figure 14.9](image1.png)  The newborn will “root” towards the side of the stimuli as a normal response. This test should be performed bilaterally.

![Figure 14.10](image2.png)  Sucking reflex. A normal response for this reflex is a hearty “sucking” onto the phalange.

![Figure 14.11](image3.png)  Blink reflex.

![Figure 14.12](image4.png)
may indicate a neurologic disturbance (Fig. 14.13A-B). If asymmetry occurs in the upper extremity, this may suggest hemiparesis or injury to the brachial plexus. Asymmetry in the lower extremity may indicate lower spinal injury or congenital hip dislocation.

**GALANT’S**

This test is also known as the trunk incursion test. While holding the newborn in a horizontal prone position, the examiner will stroke unilaterally the paraspinal musculature. The newborn should normally respond by arching the back and turning the head slightly to the ipsilateral side of the stroking stimulation. This test should be performed on both sides (Fig. 14.14). The response is present from birth to 2 months. Absence of the reflex may indicate a transverse spinal cord lesion.

**TONIC NECK**

This test is also known as the “ATNR” (asymmetric tonic neck reflex). The examiner places a hand on the crown of the newborn/infant’s head and rotates it to one side. The normal response is the extension of the arm and leg on the side of head rotation, and arm and leg flexion on the opposite side. This position is called the fencing posture. The test should be performed bilaterally (Fig. 14.15). This reflex is present by the 2nd week through the 6th month. It should be noted that this reflex in a normal newborn/infant should not always be present when the test is repeated. Findings that are abnormal and implicate major cerebral damage are a persistent present finding during each test under 6 months of age or a present finding beyond the 6th month.

**NECK RIGHTING**

The examiner rotates the head of the supine infant to one side. The normal response is for the trunk to rotate toward the side of head rotation (Fig. 14.16). This reflex is present from the 4th through the 6th month and disappears entirely at approximately 6 months.

**PARACHUTE**

The examiner holds the infant in the prone position while supporting the abdomen. Mimicking a rapid fall, allow the infant to drop a short, controlled distance. The normal response is for the infant to extend their arms, hands and fingers outward (Fig. 14.17). This reflex is present from the 9th month on.
PLACING

Being careful not to displace the shoulder joints, the examiner supports the newborn from under the axillae. While touching the dorsum of the foot on a table top, the normal response will be flexion of the leg (Fig. 14.18A), followed by leg extension (Fig. 14.18B). This reflex is detected from birth to about the 6th week. Absence of this reflex may indicate paresis due to breech delivery or other factors.

STEPPING

The examiner carefully lifts the newborn from under the axillae and touches both soles of the feet on a flat surface. The normal response is the action of walking (Fig. 14.19). This reflex is present from birth to the 6th week. The
absence of this reflex has the same indication as the placing reflex.

VERTICAL SUSPENSION

While lifting the newborn carefully under the axillae, the examiner will then quickly raise the child higher in the air. The normal response will be for the infant to flex both hips and knees (Fig. 14.20). This reflex is present from birth to approximately the 4th month. Absence of this reflex with fixed leg extensions, or adduction (scissoring effect), could indicate spastic paraplegia or diplegia.

PALMAR GRASP

The examiner places a finger in the palm of the newborn/infant from the ulnar side. The normal response will be a grasping action (Fig. 14.21).

DIGITAL RESPONSE

The examiner lightly strokes the ulnar side of the hand and fifth digit. The normal response is extension of the thumb and fingers (Fig. 14.22). Both the Palmar Grasp and Digital Response are present at birth and are normally not obtainable by the 6th month. If the grasp reflex persists beyond the 6th month, this may suggest cerebral dysfunction. A normal response for the newborn is to have the fist closed during the 1st month of life. If the newborn continues to keep the fist persistently closed beyond the 2nd month, this may indicate central nervous system dysfunction.

ABDOMINAL

The newborn/infant is placed in a supine position. The examiner, with a finger, performs a light but brisk stroke across the abdomen. To test T8 to T10, the stroke is performed in the right and left upper quadrants. The right and left lower quadrants will test T10 to T12 function. The stroke begins in the lateral superior corner of each quadrant and ends in the opposite medial inferior corner. A normal finding is abdominal muscle contraction and deviation of the umbilicus on the side of the stimulus.
This test will appear during the first 6 months of life. Absence of the reflex suggests either central motor lesion or a lesion of the spinal cord segment that was stimulated.

ANAL

The undiapered newborn/infant is placed in a prone position. With an object, lightly stroke the perianal region. A normal finding is contracture of the external anal sphincter. This reflex is usually present at birth and assesses function of the lower sacral segments.

MOTOR FUNCTION ASSESSMENT

The process of general observation includes reviewing motor function in the newborn/infant. A normal activity level of the newborn/infant is symmetrical movement of the limbs. Motor function can be tested by taking each major joint through a range of motion. A finding of spasticity or flaccidity would indicate abnormal function. A gripping action of the newborn is a normal response unless it is continually present after the 2nd month, which indicates central motor lesion.

Diffuse cerebral dysfunction may reveal itself as generalized diminished muscle tone. A sign of a hypotonic state is abduction of the hips or a "frog leg" appearance. The arms may also be abducted in this state. Increased muscle tone (hypertonia) will cause adduction of the hips and create a lower limb scissoring effect.

ORTHOPAEDIC EXAMINATION

The orthopaedic examination, although not mandatory or necessary to detect the presence of a vertebral subluxation complex, may prove useful to differentiate other physical disorders. There are a restricted number of orthopaedic tests available for examining the newborn/infant.

The preadolescent and adolescent can be examined as adults. Chapter 4 should be referred to for the indicated orthopaedic tests. The Adam’s maneuver, which is
explained and illustrated in Chapter 9, is useful to reveal the presence of a structural scoliosis.

Shortly after birth, the hip joint should be examined for possible congenital hip dislocation. Ortolani’s and Barlow’s signs are used to rule out displacement or subluxation of the femur head from its normal relationship with the acetabulum. The incidence of congenital hip dislocation is one to two for every 1,000 births (27). There are two classifications of hip dislocation: idiopathic (more common) and teratogenic. Idiopathic congenital dislocation of the hip has several poorly understood etiologies. In-utero constraint positioning, particularly the breech presentation, appears to be related (1,27). Approximately 50% of breech births (3.5% of all births) will manifest hip dislocation (1). Family history of the disorder also appears to be involved.

Females have a greater tendency for dislocation of the hip. Unilateral dislocation is found twice as often as bilateral dislocation. There is also a greater prevalence of primipara infants manifesting this disorder. Little is known about the teratogenic etiologies. They tend to be more severe and are thought to be related to a germ plasma defect.

**ORTOLANI’S SIGN**

Ortolani’s sign is performed with the newborn in a supine position. The doctor places the length of the middle finger over the greater trochanters. The thumbs are then placed at the medial aspect of the inner thigh on the lesser trochanters. The doctor should first flex the newborn’s knees to the chest, and then abduct the legs to 90°. A positive sign is elicited during the abduction phase. The femur will create a palpable “clunk” as it relocates out of the acetabulum over the posterior margin (Fig. 14.23A-B) of the hip. A positive finding indicates instability or dislocation.

**BARLOW’S SIGN**

Barlow’s sign is performed on the supine infant. Hand placement is the same as described in Ortolani’s sign. The doctor first pulls on the leg, distracting the femur, followed by a medialward push of the upper thigh (Fig. 14.24A-B). A noticeable “clunk” must be present in order for the test to be positive.

Both of the preceding tests should be performed bilaterally. A click or high pitch sound does not indicate a pos-
itive sign. An AP and “frogleg” radiograph will confirm the dislocation. For single hip dislocation, an In ilium may be involved (See Chapter 6). Bilateral dislocation may be related to a base posterior sacrum (See Chapter 7).

KERNIG’S TEST

Kernig’s test is performed with the child in a supine position. The doctor lifts the child’s leg and flexes it at the hip and the knee. The leg should then be straightened or extended from this position. Resistance because of pain is considered a positive sign. Both legs should be tested.

BRUDZINSKI’S TEST

Brudzinski’s test is performed with the child in a supine position. After placing the hands on the child’s head, the doctor then flexes the neck to the chest. A positive test is indicated when resistance, pain, or hip and knee flexion occurs.

Kernig’s and Brudzinski’s tests can both be performed if meningeal inflammation is suspected from infection (meningitis), or by blood, as seen with subarachnoid hemorrhage. Any positive findings should warrant further examinations.

SKIN TEMPERATURE INSTRUMENTATION

Hand-held paraspinal temperature differential instruments (e.g., Nervoscope) (See Chapter 4) can be a helpful component of the pediatric examination (28). The size of the newborn, infant or child will determine the setting of the width of the instrument’s probes and the patient position for performing the analysis.

The adjustable probes of the instrument must be narrowed to adapt to a newborn or infant’s spine, particularly in the cervical region. The newborn can be held against the chest of the parent. A prone position, across the lap of the parent or doctor or on the adjusting table, is an alternative to the upright position (Fig. 14.23).

The newborn or infant’s elastic skin may make the examination more difficult to perform and to obtain an accurate reading. If this is the case, a “dotting” procedure can be used (29). This replaces the normal gliding method. By lifting the probes from the skin, the paraspinal muscles can be “dotted” with the thermocouples every few millimeters.

Figure 14.26 demonstrates the toddler’s ability to cooperate during the analysis. Many toddlers may find this examination ticklish and respond by squirming. A slower glide, while holding the abdomen or shoulder with the free hand, can prevent undesired movement.

PALPATION AND OBSERVATION

The newborn or infant is best palpated while placed against the chest of the parent (Fig. 14.27) or prone across the lap (Fig. 14.28). A posterior to anterior reduction in joint movement is frequently discovered at the involved motion segment.

Atlas subluxations will show reduction in axial rotation. Axial rotation dysfunction at other segments appears to occur less often, unless there has been a specific rotational trauma. Traumatic rotational lesions can occur in the cervical region if extreme rotation occurs during the birth process (7–9, 22).

When palpating the cervical spine of the newborn, the
doctor's index finger, or the thumb and index finger can be used. For the thoracic and lumbar spine, a single or double digit, or thumb can be used to palpate (Fig. 14.29).

The palpation of the sacrum and ilium is performed in the prone position. Placing the distal end of the thumb or index pad on the sacral tubercles, the patient's legs should be raised and lowered bilaterally while creating a posterior-anterior motion (Fig. 14.30). The sacral segments most easily palpated for fixation dysfunction are S1 to S3. Posteriority of a sacral segment can be verified with a lateral radiograph.

The sacroiliac joint can be palpated by placing the thumb or finger on the superior medial aspect of the PSIS of the prone infant. The leg on the involved side should be first raised and then lowered (Fig. 14.31). The PI ilium can reveal edema at the superior portion of the joint as well as restriction in movement.

For palpation of the AS ilium, the thumb is placed on the inferior and medial aspect of the PSIS and the leg on the involved side is raised and lowered. Edema and joint restriction are usually present at the inferior portion of the joint of the subluxation. To confirm ilium findings, the doctor should place the undiapered baby in a prone position and observe the gluteal fold (Fig. 14.32). The PI ilium will have an increased gluteal fold, when compared to an AS subluxation.

The In or Ex ilium is difficult to palpate and is more easily determined through observation. In the prone position the undiapered infant with an Ex ilium will have a shorter ilia width, whereas the In ilium reveals a larger width.

Another way to determine the presence of an In or Ex ilium is to lift the infant in the air and observe the position...
of the legs and feet. The Ex ilium will cause internal rotation of the foot and the In ilium an external rotation. This observation can also be performed with the patient in a supine position.

A prone leg check also can be used to assist in evaluating ilium listings (Fig. 14.33). A short leg is observed with a PI ilium, and a long leg with an AS listing. Because of unequalized growth rate of the lower limbs of children, the leg check should not carry as much weight in the evaluation.

The toddler or adolescent can be palpated as an adult (Figs. 14.34 and 14.35). Observing the gait and stance of the toddler will assist the practitioner in determining the nature of the subluxation. Bilateral toe-in or "pigeon toe" syndrome may indicate a sacrum base posterior. This observation can be confirmed by a lateral lumbar sacral radiograph (See Chapter 7). The Ex or In ilium will cause internal or external rotation of the foot in the standing position. This finding can be confirmed with the anterior-
posterior radiograph. Postural distortions detectable by physical or radiologic examination are discussed in Chapters 4 and 5.

**PLAIN FILM RADIOGRAPHY**

Chiropractic care may be more effective if it prevents the vertebral subluxation complex from developing permanent vertebral or soft tissue asymmetry. The pediatric spine is particularly vulnerable as the cartilage makes its transition to bone. During the formative years, abnormal vertebral remodeling and deformity may occur (10,13,14,17,30). Clinical research and observation suggest that biomechanical compromise can occur in utero (constraint positions) (1–3), or as a result of birth trauma (7–9,22,31). Later, micro and macro trauma will occur in the child throughout spinal development.

The issue of radiographing children has been a topic of discussion within the profession for many years. Questions such as, at what age and which circumstances would indicate the necessity to x-ray, are very important considerations (32). Radiographic procedures for any child should include every safety precaution to reduce exposure to ionizing radiation. Shielding for the reproductive organs, as well as the brain, eyes, breast, thyroid gland, and bone marrow should be provided (Fig. 14.36A-B). If
the child is small enough, the use of a 14 × 17 film size should replace the standard 14 × 36, if a full spine radiograph is needed. As always, strict collimation to exclude the skull and femur bones from exposure should always be used.

Rare earth intensifying screens with a minimal 400 screen-film combination speed is recommended to reduce exposure time. Higher combinations such as 800 or 1200 speed are available and should be considered. A high kilovoltage technique (e.g., 90–100 kvp) and a long film focal distance (e.g., 84 inches) should be used to further reduce exposure (See Chapter 5). High frequency x-ray generators (e.g., Universal, G.E.) are preferred to decrease patient radiation dose.

A consideration in deciding when to radiograph a child is the child’s ability to hold the stance for the film. Positioning instructions should be adapted so that the child can understand the procedure. Patience in setting up the film can reduce the need for retakes. For the occasional, more difficult child to radiograph (e.g., cerebral palsy patient or the infant), the parents can assist. Lead shielding (e.g., apron, gloves) should be provided. The assistance of an outside radiologic facility may be necessary in some circumstances. If the doctor or parent chooses not to have a child radiographed, it is recommended that a x-ray waiver be signed by the parent or legal guardian.

Vertebral subluxation complexes can develop at a very early age (Fig. 14.37). Anomalies, spinal trauma, and acquired lesions such as spondylolisthesis are important in the evaluation of the patient (16,31,33–35) (Fig. 14.38A-B). Authorities within the radiologic community state that with the proper radiologic procedures, the usefulness of the information can assist in developing a more complete understanding of the pediatric spine. Spinal radiographs also are beneficial when specific thrust techniques are used.

SPECIAL CONSIDERATIONS

The pediatric patient has special requirements. The ability of the doctor to adapt procedures to the child is important in providing effective care.

The child’s age, height, and weight are considerations. The newborn and infant will normally be most comfortable and cooperative if in physical contact with a parent during the evaluation and adjustment. The toddler’s behavior may be the major factor in determining potential cooperation while on the cervical chair, pelvic bench,
knee chest, or hi-lo table. Placement of the pediatric patient for the adjustment can vary from the adult. Where the child can receive the most comfortable and effective adjustment can only be determined on an individual basis.

The doctor’s contact point for adjustments has traditionally been the pisiform and the broader aspects of the hand. The smaller size of the newborn, infant, and toddler will require the use of the distal ends of the fingers to ensure specificity. The age of the child will also determine the disc plane line before the thrust. The cervical curve, which is relatively flat at birth, begins to form the lordotic arch that becomes permanent, between the 3rd and 9th month of life (30). At approximately the 12th month, upright posture will complete the permanent lumbar curve. The thoracic and sacral curves are present at birth and remain so throughout the individual’s lifetime.

The doctor’s unfamiliarity with the pediatric spine, coupled with a general lack of gross morphologic changes of the motion segment, has often led to approaching the adjusting process in a generally unspecific fashion. Because many structural changes may take years to evidence neuropathophysiologic disorders such as symptoms, careless adjustments may have been considered relatively benign. The approach advocated here is to adjust only those articulations that are subluxated and require intervention. The haphazard introduction of a force directed into a dysfunctional motion segment, or thrusting into a normal or hypermobile articulation, should be avoided.

There are many potential sources of trauma (e.g., birth process, falls, automobile injuries) which can cause damage to the spine, spinal cord, and its supportive components (6–9,16,19,21–24,35,36). These physical traumas to children may result in stillbirth, SIDS, paralysis, functional disorders, and even death. If spinal trauma has been established to occur with children, it would behoove the chiropractor to learn from those mechanisms of injury. To repeat known mechanisms of injury to the pediatric spine with inappropriate adjustments, would obviously not benefit the child.

The pediatric patient placement and the adjustment should always prevent or minimize the following forces to the pediatric spine: traction (+Y), extension (−θX), rotation (±θY), flexion (+θX) and lateral flexion (−θZ or +θZ). The closer to the neutral position the spine can be maintained during patient placement and during the adjusting thrust, the less the likelihood of causing spinal injury.

In general, the most effective vector of thrust for the pediatric spine is from posterior to anterior (+Z) (Personal communication, Dr. Jan Jirout), excluding Cl laterality and rotation.

The depth of thrust can only be determined by the doctor. The amount of thrust should always be enough to accomplish the purpose of eliminating the vertebral subluxation. If the patient is relaxed and comfortable during the procedure, the amount of force is much less than in the adult. The foremost consideration by the doctor providing any pediatric care should always be the comfort of the child. A quick acceleration is generally required for the adjustment.

UPPER CERVICAL SPINE
Occipito-atlantal

The PS (+θX, −θZ), the doctor can place the infant between the legs and apply a gentle pressure with the thighs. The chest of the doctor also can be used to stabilize the infant. The stabilization hand is placed on the opposite mastoid process. The fingers of that hand wrap around the posterior aspect of the cervical spine. This will protect the upper and midcervical regions from undesired movements during the thrust.

The toddler and doctor in Figure 14.41 display the proper set-up for stance, contact, and stabilization hand
positioning for a PS-RS-RP $(+\theta X, -\theta Z, -\theta Y)$, with the head rotated away slightly from contact hand, and a PS-LS-LA $(+\theta X, +\theta Z, -\theta Y)$, with the head rotated slightly toward the contact hand (Fig. 14.42) (See Chapter 11).

The AS $(-\theta X)$ condyle is an uncommon subluxation. This positional dyskinesia can cause severe neurologic disturbances. Micro or macro trauma is usually the cause of the AS condyle misalignment. In-utero constraint of the fetus may be one factor in the development of the AS condyle. The face or brow presentation is typically described as a compression of the head and cervical spine into an extended position. This presentation is found in one out of every 500 births and contributes to a malady of disorders (1-3). From a biomechanical standpoint, hyperextension of the cervical spine compounded by facial compression could create a posterior occipito-atlanto-axial vertebral subluxation as well.

A newborn or infant with an AS condyle will display on postural examination a cervical hyperlordosis with a raised chin. The infant and toddler will manifest the hyperlordosis of the cervical spine. Over years of adaptation, however, compensation reactions of the midcervical spine can develop a kyphotic posture in the adult. The lateral radiograph will confirm the clinical impression. A lateral radiograph taken with the neck in flexion will demonstrate a lack of separation of the occiput from the posterior arch of the atlas (Fig. 14.43A-B). During motion palpation, the doctor should apply an anterior to posterior, superior to inferior, gliding motion. The AS condyle will cause restriction in joint play and muscular tenderness will be elicited at the posterior occipito-atlantal junction. The side of laterality and rotation can be confirmed with an APOM radiograph for both the AS and PS condyle subluxations.

Using a properly sized condyle block is important when adjusting a newborn or infant with an AS condyle. The block acts as a stabilizer for the cervical spine, thus protecting it from injury (See Chapter 11). The newborn or infant should be placed in a supine position with the condyle block supporting the cervical spine from CI to

Figure 14.40. Thumb contact for PS occiput adjustment.

Figure 14.41. PS-RS-RP $(+\theta X, -\theta Z, -\theta Y)$ adjustment with the toddler's head rotated accordingly away from the contact hand to correct axial rotation.

Figure 14.42. The toddler's head is rotated slightly toward the contact hand for axial rotation correction as depicted in this PS-LS-LA $(+\theta X, +\theta Z, -\theta Y)$ listing.
C7. To correct condyle laterality, (LS or RS listing), the doctor will stand or squat on the side of the lateral contact point. The flat palm of the contact hand is then placed on the glabella of the frontal bone. The opposite hand will cup the posterior occiput and create a slight lifting effect to separate the occipito-atlantal joint. In Figure 14.44 an AS-LS (−θX, +θZ) adjustment is demonstrated. The thrust is an arcing motion from anterior to posterior, and slightly superior to inferior (+θX). To correct the rotational component of anteriority or posteriority, the infant’s head is pre-positioned in slight rotation before the thrust. For anteriority, the head should be turned slightly toward the contact hand. In Figure 14.45, turning the head away from the contact hand will correct the posterior rotation of the AS-LS-LP (−θX, +θZ, +θY) listing.

If no laterality or rotation exists, an alternate approach can be used for correction of the AS component. The same supine position and condyle block placement is followed. However, the doctor will stand, squat or sit behind the center of the infant’s head. Both thenar eminences are then placed on the glabella. The doctor’s fingers will reach behind and contact the posterior occiput for the lift. The thrust is anterior to posterior (−Z) with a slight superior to inferior arc (+θX). Figure 14.46 demonstrates the AS condyle adjustment.

The toddler and adolescent set-up is performed in the cervical chair. The doctor will drop down the back of the chair to accommodate the height of the child and the condyle block placement. Once the proper condyle block size is chosen, it is placed on the posterior cervical spine (C1 to C7) with the abdomen of the doctor holding it in place (Fig. 14.47). In the cervical chair set-up, the flat palm of
the hand will contact the glabella and supraorbital margin on the side of condyle laterality (AS-LS or AS-RS). The stabilization hand will be placed on the opposite supraorbital margin with the fingers overlapped or interlinked. The doctor should keep their elbows close to the patient’s head. Tension pre-load is created by slightly flexing the chin downward. Figure 14.48 illustrates the set-up for the AS condyle adjustment. An AS-RS (−θX, −θZ) condyle is shown in Figure 14.49. To assist in stabilizing the patient set-up without the back of the chair, the knee of the doctor can be drawn up onto the cervical chair. Figure 14.50 depicts an AS-RS-RA adjustment, whereas Figure 14.51 illustrates an AS-RS-RP (−θX, −θZ, −θY) correction. The rotational component of anteriority or posteriority is corrected when the doctor pre-positions the head before the thrust.

**Atlanto-axial Region**

The anterolateral tip of the transverse process is contacted for the AS portion of the atlas listing. To correct laterality of the atlas (ASL or ASR), the doctor contacts the involved side. The patient placement may vary depending on the comfort and cooperation of the patient. Figure 14.52 shows the parent holding the newborn for an ASL (−θX, +θZ) listing. Unnecessary head rotation should be avoided for correction of an ASL or ASR listing. The doctor also can position the infant sitting between the legs, while applying a slight thigh pressure to reduce infant movement (Fig. 14.53 illustrates an ASR listing). Protection of the cervical spine with the stabilization hand is important.

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**Figure 14.46.** The AS condyle without laterality or rotation can be corrected by contacting the glabella with both thenar eminences. The doctor will stand, squat or sit behind and center to the infant’s head.

**Figure 14.47.** The back of the chair is dropped to accommodate the height of the toddler or adolescent. The doctor will hold with their abdomen the proper condyle block size for the posterior cervical (C1 to C7) spine.

**Figure 14.48.** The child’s chin will be slightly flexed to create pre-load tension for the AS condyle adjustment.
Figure 14.49. The flat palm of the hand will contact the glabella and supraorbital margin on the side of condyle laterality. The stabilization hand will be placed on the opposite supraorbital margin with the fingers interlinked. The doctor’s elbows should be kept close to the patient’s head as seen in the AS-RS set-up.

Figure 14.50. To assist in stabilization, the knee of the doctor can be drawn up onto the cervical chair to support the patient set-up. Rotating the child’s head toward the contact hand will correct axial rotation as seen in this AS-RS-RA set-up.

In the sitting position, the amount of head rotation before applying the thrust is in direct proportion to the degree of atlas rotation. For an anterior listing (ASLA, ASRA), the head is rotated toward the side of the contact hand. Posterior rotation (ASLP, ASRP) is corrected by turning the head away from the side of the contact hand. As seen in Figure 14.54, slight rotation is used to correct the rotational component of the ASLA (−αX, +αZ, −αY) listing. With more atlas rotation, Figure 14.55 shows the appropriate set-up for an ASRA (−αX, −αZ, +αY) adjustment.

A third alternative for adjusting the atlas is to lie the
newborn or infant in a side posture position with the head in a neutral plane. The thumb, thumb-index, or the distal end of the index finger, can be used for adjusting the atlas. Figure 14.56 demonstrates a distal index finger on top of the thumb pad for an ASR (−θX, −θZ) listing in the side

Figure 14.53. This ASR set-up shows the infant placement between the doctor's legs with slight thigh pressure. The stabilization hand will protect the cervical spine from unnecessary motion during the thrust.

Figure 14.54. The ASLA listing will have head rotation toward the contact hand.

Figure 14.55. To correct more axial rotation, the doctor will rotate proportionally the newborn's head as seen with this ASLA set-up.

Figure 14.56. Side posture position with the head in the neutral plane for an ASR adjustment.
posture position. The thrust is a set and hold (See Chapter 2). The adjustment should not be performed as a toggle-recoil. Because the purpose of the thrust is to correct atlas superiority and laterality, it is advised that a rotated atlas (e.g., ASLA, ASLP, ASRA, ASRP) not be adjusted in the side posture position. The thrust vector for correction of rotation is more difficult to achieve in this position.

With the toddler, set-up procedures are similar to the adult patient. To prepare for the atlas set-up, the head is first laterally flexed away from the side of the contact hand as seen in Figure 14.57.

After contacting the anterior lateral tip of the transverse process of the atlas with the distal end of the thumb, the cervical spine is laterally flexed toward the thumb (Fig. 14.58). The contact wrist should remain relatively flat. Figure 14.59 illustrates the proper doctor stance, contact, and stabilization hand positioning for an ASR listing. The stabilization hand is an important consideration. The doctor should gently place a hand on the opposite side of contact on the lateral aspect of the cervical spine. The purpose of the stabilization hand is to avoid compromising the other motion segments during the adjustment. During the thrust, the stabilization hand should never produce any counterforce. Figure 14.60 depicts an ASLP ($-\theta X, +\theta Z, +\theta Y$) adjustment.

LOWER CERVICAL SPINE (C2-C7)

The set-ups for the cervical region (C2 to C7) for the newborn or infant have many variations. After performing a spinal analysis, the contact finger and patient placement must be chosen. The primary vector for correction of the subluxation is from posterior to anterior (+Z).

If a straight posterior subluxation is present, the distal end of the index finger can be placed on the spinous process with the patient in a prone position (Fig 14.61). The infant also can be placed in a prone position on the parent’s lap while using the parent’s hand for stabilization. Figure 14.62 shows the distal end of the fifth phalange with the stabilization fifth phalange placed on top for a posterior second cervical listing. The side posture position can be used with the index finger making contact on the spinous process for adjustments of a posteriorly ($-Z$) displaced cervical segment (Fig. 14.63).

A sitting position set-up can be accomplished with the assistance of the parent. The parent should support the chest and back of the infant. Figure 14.64 demonstrates a
posterior midcervical set-up, using a spinous process contact. Again, the stabilization hand should not provide a counterforce. The PL or PR listing adds a lateral to medial vector to the posterior to anterior vector for correction.

The third component of the listing [lateral flexion dyskinesia ($\pm \theta Z$)] is corrected by an inferiorward arcing motion or torque added at the end of the thrust. The pediatric spine is very flexible, and special attention must be made to avoid excessive lateral flexion or hyperextension of the cervical region. The reader is referred to Chapters 10 and 11 for additional information.

The toddler can be adjusted in the cervical chair. To raise the height of the toddler in the chair, the pelvic bench pillow can be placed underneath the patient. Figure 14.65 depicts a PR ($-Z$, $+\theta Y$) set-up on the fourth cervical vertebra. Figure 14.66 demonstrates a sixth cervical PL ($-Z$, $-\theta Y$) adjustment. Notice the placement of the stabilization hand in a seventh cervical PR set-up (Fig. 14.67).

**Figure 14.60.** Rotating the head of the toddler away from the contact hand will pre-position for correction of axial rotation of the ASLP listing.

**Figure 14.61.** Posterior cervical adjustment with an index finger contact.

**Figure 14.62.** The infant can be placed prone on the lap of the parent, while they further assist by stabilizing the infant's head with their hand. This set-up depicts the distal end of the fifth phalange with the stabilization fifth phalange placed on top for a posterior second cervical listing.

**Figure 14.63.** The side posture position with the distal end of the index finger contacting the spinous process of a posterior fourth cervical. The doctor's opposite hand should stabilize the crown of the infant's head.
The right-handed set-up would be used for a PR \((-Z, +\theta Y, +\theta Z)\), or PRS \((-Z, +\theta Y, -\theta Z)\) listing on the spinous process or a PLI-la \((-Z, -\theta Y, -\theta Z)\) listing, using the lamina as the contact point. Pre- and posttreatment radiographs are shown in Figure 14.68A-B.

The upper thoracic region also can be adjusted in the sitting position. Figure 14.69 illustrates a toddler in a cervical chair third thoracic set-up. Depending on the listing, the doctor can contact the spinous process or transverse process with the distal end of the index finger. The upper thoracic region will require a more superior to inferior pattern of thrust.

**THORACIC SPINE**

Correction of thoracic subluxations is accomplished primarily using adjustments in the posterior to anterior (+Z) direction. Rotational displacements (e.g., \(-Z, -\theta Y/PL\) or \(-Z, +\theta Y/PR\)) can occur as well and are

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**Figure 14.64.** With the assistance of the parent holding the infant's stomach and back, a sitting position is shown for this posterior mid cervical adjustment.

**Figure 14.65.** The toddler's height is raised in the chair before the set-up by placing the pelvic bench pillow underneath. The back of the cervical chair has been lowered for illustration purposes only for this PR fourth cervical adjustment.

**Figure 14.66.** PL \((-Z, -\theta X, -\theta Y)\) C6 adjustment.

**Figure 14.67.** PR \((-Z, -\theta X, +\theta Y)\) C7 adjustment. Notice the stabilization hand.
corrected accordingly; however, this is usually not a primary component of the listing. The spinous process is the preferred patient contact point. A variety of patient positions and hand contacts are available to the doctor for the thoracic spine adjustment.

Three common positions are against the chest of the parent, across the lap of a parent, or across the lap of the doctor. Keeping the infant in a neutral position during the thrust and not allowing them to rotate their trunk is an important consideration. Figure 14.70 illustrates the parent holding a premature newborn for a PR (−Z, +θY) ninth thoracic listing. The doctor stands on the side of spinous laterality, using the distal end of the fifth phalange on the spinous process with the distal finger of the other hand placed on top.

The infant can also be placed prone on the parent’s lap. A double-thumb contact on the spinous process can be used for a posterior subluxation (Fig. 14.71). This double-thumb contact is only one of many combinations of finger contacts. The distal end of the index finger also can be used to set a posterior thoracic subluxation or a posterior and rotated segment (e.g., PL) (Fig. 14.72).

The hi-lo table can be used for patient placement of
the toddler or adolescent. Figure 14.73 illustrates the doctor setting-up on the spinous process of the sixth thoracic with the fleshy portion of the pisiform for a PRS (−Z, +θY, −θZ) listing. The thrust will be from posterior to anterior (+Z), lateral to medial (−θY) with an inferiorward arcing motion (+θZ) toward the end of the thrust, to correct the lateral flexion position of the segment.

To adjust a PLI-t (−Z, −θY, −θZ) listing, the doctor stands on the right side and the transverse process is contacted (Fig. 14.74). For a PRI-t (−Z, +θY, +θZ) adjustment, the left transverse process is contacted. The hand and fingers of the contact hand should not cross the spine for a transverse process contact. The PLI-t adjustment is posterior to anterior (+Z), lateral to medial (+θY), with an inferiorward arcing motion (+θZ) toward the end of the movement.

An alternative set-up is a double-thumb contact placed bilaterally on the transverse processes to correct a PLI-t or PRI-t listing. For a PRI-t listing, the left thumb contacts the left transverse process. No thrust is made with the stabilization thumb (Fig. 14.75).

**LUMBAR SPINE**

In the newborn or infant, the major lumbar positional dyskinesia is usually posteriority (−Z). This will be corrected with a posterior to anterior thrust (+Z), using the spinous process as the short lever arm. The lap of the parent can be used to place the newborn or infant in the prone position. Figure 14.76 illustrates the distal thumb
pad contact on the spinous process and the distal end of the index finger on top for stabilization. The infant also can be placed across the lap of the doctor. Figure 14.77 depicts an adjustment for a PL \((-Z, -\theta_Y)\) fifth lumbar. The doctor should place the infant's spinous laterality closest to their torso. The thrust for the PL listing is from posterior to anterior \((+Z)\) and lateral to medial \((+\theta_Y)\). The newborn or infant also can be placed against the chest of a parent (Fig. 14.78). The doctor is shown setting-up on a midlumbar with the right thumb on the spinous process and the left thumb stabilizing the contact hand.

The side posture position also can be used for the adjustment of a variety of listings. It is recommended that a finger push contact be used instead of a pisiform, to enhance specificity (Fig. 14.79). The doctor should place an index finger on the spinous or mammillary process, depending on the listing. To support the index finger, the middle finger can be placed on top of the nailbed. The purpose of the stabilization hand is to support the upper torso in a neutral position. The parent can assist the doctor by stabilizing either the upper torso or the lower limbs to prevent the infant from rotating. There should be no axial torsion of the spine. Axial rotation would compromise the integrity of the motion segment, above and below the subluxation, especially the intervertebral disc.

For a PL or PR listing, the spinous rotation is placed

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**Figure 14.75.** For this fourth thoracic double-thumb contact on a PRI-t listing, the thrust will be made on the left transverse process only.

**Figure 14.76.** The distal end of the thumb is contacting the spinous process of the posterior fifth lumbar. The distal end of the index finger is placed on top for stabilization. The infant is further stabilized by the parent.

**Figure 14.77.** PL \((-Z, -\theta_Y)\) L5 adjustment.

**Figure 14.78.** Posterior lumbar adjustment in the upright position.
toward the table. The thrust is from posterior to anterior (+Z) and lateral to medial. If a lateral flexion positional dyskinesia is present (e.g., PLS), then an inferiorward arcing motion (−θZ) should be made toward the end of the thrust. A PRI-m (−Z, +θY, +θZ) listing is adjusted with the patient on their right side (spinoius rotation down). The left mammillary is contacted. The thrust is from posterior to anterior (+Z) and an inferiorward arcing motion (−θZ) is applied toward the end of the thrust. Lateral flexion positional dyskinesia is rarely detected in the newborn or infant, unless a scoliosis is present. At no time should the doctor’s leg be placed on the infant’s or toddler’s bent leg as is traditional in some long lever techniques.

The use of the parent’s hand can be used to stabilize the legs if necessary. Figure 14.80 depicts a side posture fourth lumbar, PRI-m pisiform push set-up. The contact hand position is modified for a spinous process pisiform contact (e.g., PLS) (Fig. 14.81). The finger push contact can be used for a spinous or mammillary process contact. Figure 14.82 depicts a second lumbar PR listing set-up.

The forearm of the doctor should follow the disc plane line of the motion segment involved. To stabilize the pelvis of the older child, the doctor will gently bend a leg across the top bent leg of the patient. The doctor should create no force (weight or drop) into the patient during the adjustment. The stabilization hand on the older child should not press the shoulder down onto the table (Fig. 14.81).

PELVIS

Ilium

The simple or compound ilium misalignment does not commonly occur in the newborn, infant or toddler, unless it is trauma induced.

Figure 14.78. The index finger on the spinous or mammillary process will increase specificity for a push move on this lumbar vertebra. To support the index finger, the middle finger is placed over the nailbed. The purpose of the stabilization hand is to support the upper torso in a neutral position.

Figure 14.80. The fourth lumbar is contacted with the left mammillary up for a PRI-m adjustment.

Figure 14.81. PLS L5 adjustment. The fingers of the contact hand cross the spine. To stabilize the pelvis, the doctor will gently place his or her leg across the top bent leg of the child.

Figure 14.82. L2 PR adjustment. The spinous laterality is placed down toward the table when a finger push move is used (See Chapter 7). The stabilization hand should not pin the shoulder onto the table.
Figure 14.83. A, The side posture position can be used to contact the PSIS with the pisiform on the PI ilium. B, PI ilium adjustment for the toddler.

Figure 14.84. The distal end of the thumb is shown contacting the PI ilium with the involved side toward the doctor.

Figure 14.85. In the prone position, the PI ilium can be contacted with a distal thumb on the PSIS with the opposite thumb placed over the navel.

The involved side is positioned up in the side posture for a PI (−θX) ilium. Figure 14.83 illustrates a pisiform contact for a push set-up. The distal end of the thumb also can be used to contact the ilium (Fig. 14.84). A PI ilium set-up in the prone position with a finger contact is a third alternative (Fig. 14.85). The thrust is from posterior to anterior (+Z), with a slight inferior to superior (+θX) arc.

The forearm in all ilium listings should reflect the sacroiliac joint plane. As previously described in the lumbar section, the infant and older child should be properly stabilized.

Figure 14.86 illustrates an AS (+θX) ilium adjustment. This is performed in the side posture position with the involved side up. Contact is made on the posterior rim of the acetabulum with the pisiform. The fingers will gently rest across the buttocks of the infant. The prone position can be used for an ilium adjustment (Fig. 14.87). The thrust is from posterior to anterior (+Z) with a slight superior to inferior (−θX) arc.

Figure 14.88 depicts Ex ilium adjustments (involved side against the table) in the side posture position. The doctor contacts the lateral border of the PSIS of the infant/toddler with the distal ends of two or three metacarpals. The adolescent is contacted with the proximal end of the metacarpals. The prone position is depicted for a thumb contact Ex ilium (Fig. 14.89). The direction of the fingers when the doctor places the pisiform on the thumb is important as it creates a line of correction. The thrust for an Ex ilium is from lateral to medial (+θY/lt. ilium, or −θY/rt. ilium).

Figure 14.90 depicts adjustment for an In ilium using a pisiform contact. The involved side is placed up, and contact is made on the medial border of the PSIS. An alternative contact is to use the distal ends of two or three phalanges to finger push the In ilium (Fig. 14.91). Figure
14.92 illustrates the thumb-pisiform contact for a prone ilium adjustment of the infant. The thrust is from medial to lateral \((-\theta Y/lt. ilium or +\theta Y/rt. ilium)\).

The side posture adjustments for a PLIn ilium using a pisiform contact are depicted in Figure 14.93. Figure 14.94 illustrates a prone position, thumb-pisiform contact for a PLIn ilium. The thrust is from posterior to anterior (+Z), inferior to superior (+\theta X), and from medial to lateral \((-\theta Y/lt. ilium or +\theta Y/rt. ilium)\).

Figure 14.95 depicts an ASIn ilium adjustment in the side posture position. Contact is made on the posterior rim of the acetabulum with the pisiform. The doctor should always take into consideration the plane line of the sacroiliac articulation when making the adjustment. The thrust is from posterior to anterior (+Z), slightly superior to inferior, and medial to lateral \((-\theta Y/lt. ilium or +\theta Y/rt. ilium)\).

ASEx adjustments in the side posture position are illustrated in Figure 14.96. The involved side is placed toward the table. The distal portions of the metacarpals are used as the doctor’s contact point for the infant. For the toddler, the proximal ends of the metacarpals will be the contact points. Contact is made on the posterior rim of the acetabulum. The thrust is from posterior to anterior (+Z), superior to inferior \((-\theta Y)\), and lateral to medial.

Figures 14.97 depicts the side posture position for a PIEx ilium adjustment. The contact is made by either the distal portion of the metacarpals (for newborn/infant) or the proximal portion (for a toddler/adolescent). The thrust is from posterior to anterior (+Z), inferior to superior \((-\theta Y)\), and from lateral to medial.

**Sacrum**

Posteriorly displaced sacral segments are relatively common in patients with unfused sacrums. These can be adjusted similarly to posterior subluxations of the lumbar spine. It is important that the contact be specific on the involved sacral segment.

The toddler or adolescent is usually adjusted in the side posture position similar to the adult. Careful positioning is important and the doctor should avoid unnecessary torsion by pushing with the stabilization hand. Care must be taken to avoid torquing the lower spine with the thigh stabilization. Figure 14.98 depicts a thumb contact for a posterior sacral segment in the side posture position. A distal end finger contact for a posterior sacral segment is depicted in Figure 14.99. The prone position is illustrated for a posterior sacral segment adjustment (Fig. 14.100A-B). The doctor can use a double thumb, a single thumb, or a pisiform contact on the second sacral tuber-
Figure 14.88. A, Ex ilium adjustment in the newborn. B, Ex ilium adjustment in the toddler.

Figure 14.89. In the prone position, the thumb contacts the infant’s Ex ilium. The stabilization pisiform will contact the nailed and the fingers will follow the plane line of the sacroiliac joint.

Acute Nasopharyngitis

Acute nasopharyngitis is also referred to as upper respiratory tract infection or the common cold (39). Children are symptomatically more affected than adults. This is considered the most frequent infectious disorder of children. Other areas that also can become involved in this process include the nasopharynx, middle ear, and paranasal sinuses. In patients with compromised immune systems, upper respiratory infection can often lead to pneumonia.
Figure 14.90. A, The pisiform contacts the medial border of the PSIS for the ilium adjustment. With the involved side toward the doctor, the contact hand gently places the fingers on the buttocks. B, Ilium adjustment in the toddler.

Figure 14.91. Finger push ilium adjustment.

Figure 14.92. Prone ilium adjustment.

Figure 14.93. A, Pelvic ilium adjustment. B, Pelvic ilium adjustment in the toddler.
CLINICAL SIGNS AND SYMPTOMS

The younger the child, the more severe the possibility of the infectious process. Infants three months and younger are usually afebrile. Fever, irritability, restlessness and sneezing are seen with infants three months and older. The older child can manifest the above signs, as well as sinusitis, headaches, malaise, and anorexia.

CHIROPRACTIC EVALUATION

See Chapter 13 on respiratory system infection for information.

Colic

The term colic describes the severe and constant cries of an infant with paroxysmal abdominal pain. It is speculated that irregular gastrointestinal peristalsis or unintegrated autonomic function of the newborn are related.
This condition is usually observed during the first month of life and spontaneously disappears by the third month; however, children may experience other dysfunctions during childhood, such as constipation (39,40).

CLINICAL SIGNS AND SYMPTOMS

The attack is characterized as a sudden onset of violent crying, drawing of the legs to the abdomen, and stomach distention. The episode may last for hours.

CHIROPRACTIC EVALUATION

The celiac plexus provides the sympathetic nerve supply to the stomach via the gastric and gastroepiploic arteries. The sixth through the ninth thoracic segments of the spi-
nal cord provide the efferent sympathetic fibers to the stomach. The anterior and posterior vagal trunks supply the parasympathetic nerve supply (37).

A study on colic by a Danish group of chiropractors (41) revealed positive results when adjustments were rendered. A second study by Klougart et al. (42) on 316 cases of infantile colic reported success within the first two weeks in 94% of the cases. Both studies warrant further controlled research in this area.

The spinal areas to note for a vertebral subluxation in these children are the thoracic region (e.g., T4 to T9) and the upper cervical region (e.g., C1-C2).

**Digestive Dysfunction**

A wide variety of digestive disorders can occur with the newborn, toddler, and adolescent. Common disorders that affect children range from vomiting, nausea and upset stomachs, to “picky” eating and loss of appetite leading to malnutrition.

Other than the few studies that have been performed in the area of infantile colic, little literature exists. Further research is needed in this area. The reader is referred to Chapter 13 for further discussion.

**Enuresis**

The condition of enuresis is the persistence beyond the age of five of involuntary discharge of urine when voluntary control should be developed. Enuresis or bedwetting normally occurs during the sleep period of the child. Boys more frequently than girls tend to manifest this disorder (39,40).

**CLINICAL SIGNS AND SYMPTOMS**

Nocturnal enuresis can be of two forms: persistent and regressive. Persistent enuresis is a continuous pattern of wet nights, whereas the regressive type has inconsistent recurrence after dry periods. A third manifestation of enuresis is diurnal. This is uncontrollable dribbling during the day that does not typify occasional accidents.

**CHIROPRACTIC EVALUATION**

The bladder receives its parasympathetic fibers from the pelvic splanchnic nerves. The nerve supply from T11, T12, L1 and L2 provide sympathetic fibers. The visceral nerve plexus also contributes both sympathetic and parasympathetic fibers (43).

A study of fourteen enuresis cases by a group of osteopaths correlated traumatic injuries with findings of interosseous lesions. Correction of the lesions produced excellent results (44). Gemmell (45) reports a case of enuresis which resolved while under chiropractic care. Future controlled studies are needed, in light of the apparently positive results of these studies.

The vertebral subluxation complex is commonly detected at the second or third sacral segments, or the fifth lumbar. A second region to evaluate is the lower thoracic and upper lumbar region (T11 to L2). The upper cervical area (e.g., C0 to C2) should also be analyzed (46).

**Febrile Convulsions**

The simple febrile convolution usually occurs between the age of 6 months to approximately age 5 years. This seizure is a form of the general tonic-clonic seizure. The criteria for identification of the seizure is that the fever be greater than 38°C centigrade during an attack which lasts under 15 minutes. There should be no other central nervous system infections or neurologic abnormalities. Genetic factors appear to also be related (39).

**CLINICAL SIGNS OR SYMPTOMS**

Before the attack, the febrile convolution is preceded by a quick onset of increased body temperature. The nature of

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Figure 14.100. A, Double thumb contact for posterior sacral segment. B, Thumb-pisiform contact for a posterior sacral segment.
the seizure is tonic-clonic or atonic. Normal alertness returns soon after the brief postural stupor.

CHIROPRACTIC EVALUATION

The vertebral subluxation complex may be detected in the upper cervical region (C1 to C2) and/or the mid to lower thoracic area (T8 to T10). The author’s clinical observations suggest that this disorder can be helped with chiropractic care. Please refer to Chapter 13 for additional information.

Foot Flare

Internal or external rotation of the foot can be seen unilaterally or bilaterally. Foot flare is usually detected at the onset of the development of walking. In many instances by the age of 4 or 5 years, the flare will resolve by itself (27).

CHIROPRACTIC EVALUATION

The evaluation of the vertebral subluxation should be directed to the sacroiliac articulations. With a singular internal foot rotation, an Ex ilium on the same side may be involved. Bilateral internal foot rotation is commonly caused by a base posterior sacrum. External foot rotation is more commonly unilateral. On the side of foot involvement, a possible In ilium or sacral rotation (P-L or P-R) may be related.

Growing Pains

The onset of growing pains usually occurs between the ages of 3 and 6 years. The etiology is unknown.

CLINICAL SIGNS AND SYMPTOMS

Usually the child will manifest enough shin pain to interrupt sleep.

CHIROPRACTIC EVALUATION

Areas to observe for the vertebral subluxation complex are the lower lumbar (L4 and L5), the sacrum, or an ilium involvement. Gutmann (11) reported improvement with children with this disorder when an upper cervical subluxation was adjusted. Foot disorders (e.g., pronation, navicular subluxation) may also be related (See Chapter 16).

Headache

The chiropractic care for patients with headache is discussed in Chapter 13. The reader is referred for additional information. By seven years of age, approximately 37% of all children will have manifested headaches. Nearly 3% of these will be of the migraine variety. Sixty-nine percent of all adolescents will have manifested headaches by the age of 14 years. Approximately 11% are migraine in nature (39, 47).

CHIROPRACTIC EVALUATION

Regarding pediatric headaches, Lewit (15) considers the cervical spine as a frequently related site. He adjusted two groups of children suffering from migraine and nonmigraine headaches. Of the 27 migraine children in the study, 24 experienced excellent results after spinal adjustments. In the nonmigraine headache group, 28 of the 30 children obtained positive results with adjustments.

Jaundice

Jaundice is the accumulation in the skin of bilirubin. This condition is observed in 60% of term infants and 80% of preterm infants. In the extreme case scenario, the disturbance of the production, metabolism, and excretion process of bilirubin can severely impair the function of an infant (39, 48).

CLINICAL SIGNS AND SYMPTOMS

The color of the skin will usually appear from shades of bright yellow to orange. Some infants will manifest poor feeding and lethargic activity levels. Lab tests can establish the amount of bilirubin accumulated.

CHIROPRACTIC EVALUATION

The liver is innervated by the sympathetic and parasympathetic (vagal) system. The celiac plexus will branch off to the hepatic plexus to the liver. This plexus will receive filaments from the right phrenic and left and right vagus nerves (43). The seventh to tenth thoracic segments originate mainly in the preganglionic sympathetic fibers and pass to the celiac plexus via the sympathetic trunk ganglia and the greater and lesser thoracic splanchnic nerves (49).

A vertebral subluxation is commonly detected at the mid to lower thoracic region (T7 to T12). The author’s clinical observations suggest that the incidence of jaundice can be greatly diminished if the mother receives care during pregnancy.

This may be due to enhanced neurophysiologic function between the mother and fetus, or decreased spinal biomechanical stress on the fetus from preventing or correcting in-utero constraint, and decreased labor-delivery time. Clinical research should be conducted to evaluate the suggested hypotheses.
Otitis Media

Otitis media is an inflammation process of the middle ear. It is usually accompanied by effusion or fluid collection in the middle ear area. Several authorities suggest that by the age of three, approximately two-thirds of all children will have had at least one otitis media episode. By the age of two, one-third of all children will have experienced up to three episodes (39).

There are three classifications of otitis media: acute (<3 weeks), subacute (3 weeks to 3 months), and chronic (>3 months). The type of the exudate will further define the different classifications (39,50).

Otitis media may be preceded by upper respiratory infection, the common cold, a sore throat, or sinusitis. The eustachian tube also may be involved and disrupted by these dysfunctional states.

CLINICAL SIGNS AND SYMPTOMS

Some children may manifest a variety of signs; however, they do not have to manifest all the clinical findings. Infants may pull on their ears or the general area. The tympanic membrane appears more inflamed in the acute stage. Concurrent signs can include fever, decreased hearing, and discharge.

CHIROPRACTIC EVALUATION

The tympanic membrane and the middle ear are supplied by several branches of nerve fibers. These nerve branches are the trigeminal (CN V), vagus (CN X), glossopharyngeal (CN IX) and facial (CN VII) (43).

At the spinal levels of C1 through C4, the cervical plexus receives motor fibers that can be traced from the tensa veli palatine (eustachian tube) to the superior cervical sympathetic ganglion (51).

Gutmann reports (11) a tendency toward ear, nose, and throat infection in children with upper cervical subluxation. Clinical observations suggest that subluxation of the mid to upper cervical region (i.e., C1 to C4), and occasionally the upper thoracic and lower cervical area is involved.

Scoliosis

The reader is encouraged to review Chapter 9 before proceeding. Chiropractic care may be most effective if a preventive approach is adopted. The writings of Smith (1) and Dunne et al. (2) suggest that in-utero constraint can cause morphogenic alterations (e.g., scoliosis) due to extrinsic forces. In a study by Dunn (3) on 6,000 breech presentations, 42% had postural scoliosis. The in-utero position of transverse lie also was considered to be another cause of scoliosis. The Webster In-Utero Con-

straint Turning Technique may reduce the incidence of postural scoliosis in newborns.

Farfan (30) states that asymmetric vertebrae are common in scoliosis. The vertebral body shows a decrease in vertical height on the side of curve concavity. On the side of convexity the pedicles are longer and the neural arch appears fuller.

Effective and noninvasive alternative methods for evaluating scoliosis in children (i.e., pre-school, elementary) should be a high priority for the chiropractic profession. Developing vertebrae can acquire asymmetries (4,10,13,14,17,30), which later may contribute to the development of scoliosis. Scoliosis may be greatly diminished if earlier detection and spinal adjustments are used. A preliminary study by Cooke et al. (52) used thermography to identify the presence of scoliosis in a group of adolescents. In a blinded analysis of randomly selected thermograms, the examiners correctly identified most normal and abnormal patients. The sensitivity of the thermographic examination was 98.2% and specificity was 91% (See Chapter 4). The reference test was a radiologic examination.

Thermography should be considered in the screening of adolescents for scoliosis. Its noninvasiveness should prioritize its integration into school screening programs.

All schools should have spinal education in their curriculum and adolescents should be educated regarding the spine, nervous system, vertebral subluxations (including chiropractic care as a health alternative for the individual), and scoliosis. Spinal hygiene habits should also be discussed with the objective of reducing the incidence of spinal trauma. The effect of various sporting events (See Chapter 2) on the development of spinal injuries needs to be acknowledged.

Tonsillitis

The term tonsils commonly refers to the two faucial tonsils. The adenoids refer to the pharyngeal tonsils (50). Approximately 30% of all the children in the United States have removal of their tonsils and adenoids. Only 1 to 2% of the children, however, are considered candidates who truly require the procedure (50) (See Chapter 4). Unfortunately, the hypertrophic or large tonsil in very young children is often misdiagnosed as abnormal. After the age of eight, the tonsil will usually return to its normal size, when normal atrophy begins to occur (50).

CLINICAL SIGNS AND SYMPTOMS

Acute tonsillitis is most commonly seen during the ages of four to seven but can occur throughout the childhood and into the adult years. Chronic tonsillitis is defined as recurrent or a persistent sore throat. The signs range from
throat inflammation and irritation to obstruction in swallowing and breathing.

Adenoidal hypertrophy is accompanied frequently with chronic tonsillitis. Mouth breathing, snoring, and persistent rhinitis are commonly associated signs.

CHIROPRACTIC EVALUATION

The plexus that innervates the tonsillar region is formed by branches of the vagus and glossopharyngeal nerves. The pharyngeal plexus also contributes branches (43). The mid to upper cervical region (i.e., C0-C4) should be closely examined for the presence of a vertebral subluxation complex. Gutmann (11) reports amelioration of tonsillitis in children who received upper cervical adjustments. Lewit (15) found that 92% of children with chronic tonsillitis had upper cervical subluxations. Gutmann (11) further cites the observations of Mohr who states that when the disturbance of the functional atlanto-occipital joint was corrected, no tonsillectomies were necessary.

Torticollis

This condition is sometimes referred to as “wryneck” (53). The sternocleidomastoid muscle is contracted on one side, with the head tilted toward the side of contraction and the chin rotated away. As the muscle deformity continues, a fibrotic mass can develop in the midportion of the sternocleidomastoid muscle. In chronic cases where intervention does not occur, facial asymmetry can result. There are two general forms of torticollis: congenital and acute (See Chapter 10).

CLINICAL SIGNS AND SYMPTOMS

Congenital torticollis is seen immediately or shortly after birth. The head of the supine newborn should easily rotate 90° in both directions. The decreased range of motion associated with torticollis may not be apparent until after the first week. The firm muscle mass will usually not appear unless the condition has been chronic for two to three months. Congenital torticollis has been found in 20 to 25% of breech (in-utero constraint) presentations (1,3). Birth trauma also appears to be related (8,11,53).

Acute or spastic torticollis is usually observed in the child after a mild cervical trauma (27), or after an upper respiratory or tonsillar infection (53).

If other causes are suspected, radiographic evaluation should be used to rule out Klippel-Feil anomaly, cervical fracture, dislocation, and osseous infection (31,39,53).

CHIROPRACTIC EVALUATION

Several sources (11,27,53) have attributed upper cervical (i.e., C0 to C2) subluxation, such as atlanto-axial rotatory fixation, as a cause of torticollis.

The upper cervical region (C0 to C3) and the upper thoracic (T1 to T4) area should be evaluated for the presence of subluxation (See Chapter 10).

CHALLENGED CHILD

The handicapped child is an individual who can derive great benefits from chiropractic care. Rather than seeing the child as having physical and mental deficiencies which restrict normal achievements, the chiropractor should adopt a perspective that the child must use all resources and abilities (i.e., challenged).

Children with scoliosis, paralysis, spina bifida, cystic fibrosis, muscular dystrophy, cerebral palsy, and other disorders will have abnormal stresses placed on the spinal column and its associated components. Physical limitations from abnormal posture, inability to participate in normal physical activities, or apparatus restrictions (e.g., wheelchairs, crutches, braces) further contribute to spinal biomechanical compromise. These factors may cause a vertebral subluxation and thus nervous system dysfunction.

Optimal neurologic function is of benefit to the patient with Down syndrome, just as it is in an otherwise “normal” individual. This applies as well to mental retardation and other neurologic disorders.

Introduction of the challenged child to the chiropractic office brings its own unparalleled demands. Case histories may need to be more extensive and extra time is usually necessary. The examination (chiropractic, physical, neurologic and orthopaedic) may need to be expanded or tailored to the child’s abilities and limitations.

Motion palpation and instrumentation examination can be assisted by the parent or paraprofessional. Figure 14.101 shows a 6-year-old cerebral palsy child being examined with the Nervoscope.

Radiographing these children in the office will normally require extra assistance by a parent and paraprofessional (Fig. 14.102). It may be necessary to use an outside radiologic facility in the more difficult cases.

The doctor must thoroughly evaluate the child with regard to the patient’s own unique normal and abnormal spinal biomechanical functions before the adjustment. The pediatric evaluation and adjusting procedures presented earlier should be reviewed. New technical skills may be required in providing an adjustment for a challenged child. Figure 14.103 illustrates a prone double-thumb contact on a midthoracic vertebra of a cerebral palsy patient.

Attention Deficit Disorder (Hyperactive Syndrome)

The term “attention deficit disorder,” or ADD, designates the central disturbances of a group of children labeled as suffering from hyperactivity, hyperkinesia, minimal brain
damage, and/or minimal cerebral dysfunction. Depending on the definition, an attention deficit disorder with hyperactivity is estimated to occur in 5 to 10% of school-age children (39). Hyperactivity is often overlapped with learning disabilities. The incidence of hyperactivity in boys is four to six times more frequent than found in girls (39).

CLINICAL SIGNS AND SYMPTOMS

About twice as many children with attention deficit disorder have associated motor overactivity than those who do not. Evidence suggests that these two conditions have significant differences: children with ADD and hyperactive traits have been found to demonstrate aggressive behavior with little expression of guilt, more commonly poor school performance, and unpopularity with their peers (39).

Nonhyperactive children with ADD are anxious and socially withdrawn and in addition to poor academic performance, have difficulty participating in sports. In general, children with ADD have short attention spans, are distractible and impulsive, and tend to act without considering or reflecting upon the consequences of their behavior. Further, they have a low tolerance for frustration and are emotionally labile and excitable. The moods of these children tend to be neutral or oppositional.

CHIROPRACTIC EVALUATION

The upper cervical region (C0 to C3) should be analyzed for vertebral subluxation. As in the case of any patient, the entire spine should be examined, and subluxations, if present, reduced. Giesen et al. (54) demonstrated improvement in children with hyperactivity after chiropractic treatment. The authors suggest more investigation in this area, in light of the potential for non-drug intervention in children with this disorder.

Hinwood and Hinwood (25) report improvement in patients with psychic disorders (related to sympathetic fiber irritation) after cervical adjustments.

Lewit's review of the literature (15) found that patients with poor motor patterns and imbalance of muscle groups showed patterns of minimal brain dysfunction.
Cerebral Palsy

In the United States, approximately 300,000 individuals manifest this nonprogressive central motor deficit. Cerebral palsy is considered as a group of disorders with a variety of etiologies.

Several causes that have been attributed to cerebral palsy include physical trauma to the brain from birth (39), obstetric complications (47, 55, 56), and breech presentations and delivery (1–3).

CLINICAL SIGNS AND SYMPTOMS

There are several classifications of this disorder of impaired motor function. The clinical picture will depend on the severity of the intellectual impairment.

CHIROPRACTIC EVALUATION

A vertebral subluxation is often detected in the upper cervical region in these patients. An AS occiput is commonly present. The lateral cervical radiograph (both neutral and flexion view), visual inspection and palpation can assist in identifying the subluxation. In younger children, the floppy head presentation may necessitate adjusting the AS occiput in the supine position (Fig. 14.104). Because of the extensive spastic contractures, a full spinal analysis is always recommended.

Arbuckle (56) discusses the need for examining the cranium and the upper thoracic spine and providing adjustive care where indicated. Normal autonomic nervous system tone is requisite for optimal blood circulation in the brain (56).

Down Syndrome

Down syndrome is sometimes referred to as mongolism (39, 57). This condition is due to an extra chromosome (21-trisomy). In the general population, one out of every 600 to 800 live births will have this chromosomal abnormality. There are two other autosomal trisomic syndromes; 18-trisomy and 13-trisomy.

CLINICAL SIGNS AND SYMPTOMS

The three more common autosomal trisomic syndromes have a wide range of clinical signs. Characteristic features are mental retardation, congenital heart disease, and abnormalities of the cranium, face, abdomen, pelvis, hands, and feet.

CHIROPRACTIC EVALUATION

Careful attention should be focused to the upper cervical region (i.e., C0-C3), because approximately 20% of these children are born without a transverse ligament of the atlas (16). Radiographic studies are mandatory to evaluate the atlanto-dental interval (ADI). The normal ADI distance is 2 to 5 mm, on a lateral cervical radiograph. Any distance greater than 5 mm is indicative of atlantoaxial ligament instability (33). A minimum of a neutral lateral cervical radiograph and flexion views are required before any cervical adjustment.

Epileptic (Seizure) Disorders

There are two classes of recurrent seizures. The first is termed “symptomatic” and occurs in response to a specific cause. This normally occurs with children under the age of two. The second class of seizure is termed “idiopathic.” This seizure often persists into adulthood. Approximately 10% of all children will manifest one or more seizures during their childhood. In the adult population, only 1% will have some form of epilepsy (39, 47).

CLINICAL SIGNS AND SYMPTOMS

Within the two classifications of seizures are numerous subclasses that can be differentiated with the EEG. Reviewing Chapter 13 and other sources (39, 47) is suggested.

CHIROPRACTIC EVALUATION

The vertebral subluxation is commonly discovered in the upper cervical region (C0 to C2). The sacral area may also be related.

Gutmann (11) reports an adjustment of an infant suffering from cerebral spasms which were resolved when the atlas-occiput relation was corrected. The disturbance appeared only after the child had been dropped on several
occasions on the head. Infantile spasms also appear to be correlated to seizure disorders (39).

**CHILD-PROOFING THE CHIROPRACTIC OFFICE**

Child-proofing the office is an important concern for all chiropractors who participate in a pediatric practice. When observing the office environment, one must review it with a very critical eye for younger children. Safety considerations are primary.

An area often overlooked by many is cleanliness of the office surroundings. Parents, in particular, will evaluate the office in this manner. Floor cleanliness is especially important. A few small objects to watch for are paper clips, pen tops, loose staples, and bottle caps. Younger children will not hesitate to place small objects in their mouths. These small objects are a common cause of choking accidents.

The reception room is an area of frequent use by children and this should be carefully surveyed. Sharp corners on low tables can become a road block for a running toddler. The doctor should be aware of items on table tops that could be accidentally pulled off by an adventurous little one. Lamps, art work, and plants are a few items that should be arranged differently.

Throughout the office, electrical outlets that are not in use should be covered with plastic plugs. This common electrical hazard is preventable. Other electrical concerns include frayed cords that should be replaced and the placement on floors of cords that can potentially be tripped over.

Chemical items should be put out of the reach of all children. In the bathroom and kitchen area, cleaning products should be locked-up or placed out of reach. This also should be true for any practitioner who may have physiotherapy items accessible to children.

It is advised that the office have a policy not to allow any child to go unsupervised in the adjusting or physiotherapy areas. The staff should inform parents of this policy. Electro-mechanical adjusting tables such as the hi-lo, are for use only by the doctor. This should be clearly explained to both the child and parent.

**CHIROPRACTIC CARE OF PREGNANCY**

From the previous discussion of in-utero constraint, it becomes obvious that pediatric care begins before the child is born. Unfortunately, little research exists regarding chiropractic care during pregnancy. The few studies that have been performed only address the issues of lumbar pain during pregnancy or labor.

One interprofessional study conducted by a chiropractor and a medical doctor (58) revealed that 75% of those women who received chiropractic adjustments during their pregnancy stated that they benefitted from care of their complaints of lumbago, dorsalgia, cervicalgia, cephalgia, and vertigo.

Diakow et al. (59) performed a retrospective study of chiropractic care and its effects on lower back pain during pregnancy and labor. The results demonstrated significant improvement in symptomatology. The majority of the women who were chiropractic patients experienced no back labor.

Low back pain and its associated complaints (e.g., leg pain) during pregnancy appears to be a common occurrence. The number of women who experience pain during pregnancy can range from 48 to 56% (60). Although a majority of these women manifest lumbar pain in their last trimester, one study (60) revealed that 28% had symptoms already by the twelfth week of gestation.

Risk factors for low back pain during pregnancy include previous back problems, a young age, and multiparity (61). There also appears to be an ethnic predisposition. Caucasians were found to be at higher risk when compared with Hispanics (60).

Many etiologies have been considered in the pathogenesis of low back pain during pregnancy. The increased biomechanical load on the spine, as well as the shape of the spine during pregnancy, may be related. Other factors include ligamentous laxity due to relaxin (which will increase ten-fold), a bulging intervertebral disc, direct fetal pressure, and vascular obstruction (60,62).

Guthrie (63) did a study on the benefits of back pressure during labor. He distributed a questionnaire to 175 women. One hundred thirty-four responded that they had experienced back labor either alone or in conjunction with front labor. During labor, 71.8% received back pressure from their husbands, and 12.6% from nurses. Those patients who received back pressure for relief of back pain, resulted in the following changes: 24% had complete relief; 41% had 80% relief; 18% had about 50% relief; and 25% had some relief. Although this was a preliminary study, Guthrie discusses the possible role of osteopathic care during labor, because of the neuroanatomic relationship of the lumbosacral region. During the first stage of labor, pain is sensed through the visceral afferent nerves that pass through Frankenhauser's ganglion in the pelvic plexus and in the middle and superior hypogastric plexus between the tenth thoracic and the first lumbar segment. The second stage of labor originates in the perineum through the second to fourth sacral segments. Uterine contractions could cause lumbar myalgia through reflex mechanisms.

Melzack and Belanger (64) found that both labor pain with back pain and low back pain during menstruation, shared common underlying mechanisms. The authors noted that low back pain was not directly caused by labor contractions, because the pain was persistent between contractions. One possible cause was reflex spasm in those skeletal muscles served by the same spinal segments as the
If this theory is correct, then this would support the clinical observations of many chiropractors: women patients who receive adjustments before labor have a reduction in the facilitation of these spinal segments. Burns (65,66) conducted two studies on the relationship of vertebral lesions and pregnancy in laboratory animals. The first study was the observation of vertebral lesions during pregnancy. Through clinical experience and animal experimentation, Burns justified that a relationship of the upper lumbar spinal region with the pelvic viscera existed. Further, she discovered that vertebral lesions were responsible for causing interference in the physiologic functions of the region. This study also suggested that upper cervical lesions could contribute to abnormal function of maternal physiology during the course of pregnancy. Maternal physiologic alterations reported from cervical lesions included disturbances in the circulation of the entire body due to cardiac malfunction, thyroid dysfunction, and sexual disturbances. Vertebral lesions in female laboratory animals also produced miscarriages, behavioral changes, premature births, stillbirth, “runty” offspring, and early death of the young. Burns further speculates on the clinical experiences of her colleagues with human pregnancy. Lesions of the lumbar spine, innominates and upper thoracic region, when adjusted, had some interesting effects. Females with vertebral lesions had pregnancies and labor that were more abnormal, compared with nonlesioned females. Burns also cites empirical evidence that previously sterile couples were able to conceive after osteopathic care.

The other study by Burns (65) demonstrated that maternal lumbar lesions of rabbits had effects on the development of their young. It was reported that a physiologic difference was noted between the young of lesioned mothers compared with the young of nonlesioned mothers. Physiologically, the young of lesioned mothers demonstrated stunted growth, erratic behavior, slow development and implications of anatomic deformities. Further, the study mentions various obstetrical complications occurring with mothers suffering from these lumbar lesions.

Historical work in this area demonstrates the potential neurologic effects of the vertebral subluxation complex on both the mother and unborn child. Further investigation in this or related areas is clearly warranted based on these early investigations with laboratory animals.

Fallon (67) correlates the following neurologic conditions associated with subluxation in pregnancy: meralgia paresthetica, brachial, intercostal, and sciatica neuralgia, coccydynia, carpal tunnel syndrome, Bell’s palsy, and traumatic neuritis. The benefits of reduction of labor time also was reported from the case history files of Fallon. Without chiropractic care, the primigravida female labored approximately 14 hours and the multiparous female approximately 9 to 10 hours. With chiropractic care during pregnancy, she reported in primigravida cases, approximately 8 to 9 hours of labor. Multiparous females had approximately 4 to 5 hours of labor. The personal observations of this author suggests that labor time can be further reduced with appropriate chiropractic care. Visit frequency generally averages two per month up until the seventh or eight month of gestation. The frequency is then increased to approximately one visit per week until delivery. A variety of factors will contribute to the time variables of labor. It appears that chiropractic care may have an influence. The author advocates further studies in a controlled environment.

Examination

Similar chiropractic evaluation procedures that are performed on the adult can be performed on the pregnant patient. Instrumentation and static palpation rarely differs significantly for the analysis of the pregnant patient. Motion palpation and postural analysis will alter because of the hormonal influence and weight bearing changes of the musculoskeletal system. Noticeable changes expected to occur during pregnancy are an increased lumbar lordosis and sacral base angle, increased segmental mobility (particularly of the sacroiliac and pubic articulations), a shift of weight bearing to the heels, and gait alterations.

Unless previous radiographs are available for review, radiographs are usually not performed on the pregnant patient (See Chapter 5). Any female who is of child-bearing age should be required to answer on the case history form if there is a possibility of pregnancy. Whoever performs the actual task of exposing the radiographs in the office should verbally inquire if there is a possibility of pregnancy and record the answer. A sign also should be posted in the radiography room, thus informing the patient to immediately notify the staff of pregnancy. If pregnancy is confirmed, a signed waiver stating that radiographs were omitted from the examination should be placed in the patient’s file before the adjustment.

In the case of cervical trauma (e.g., whiplash), one may consider limited cervical views to rule out the possibility of fracture (68). Before the radiographic procedure for the pregnant female, discussion with the patient, spouse and obstetrician may be necessary to answer any questions. The involved parties should be informed of the safety precautions provided. This should include the wearing of a full-trunk lead apron and brain, eye, and thyroid shielding.

Adjustment

During the course of pregnancy, hormonal changes will alter the function of musculature and other supporting structures. This alteration normally creates hypermobil-
ity of the spinal motion segments and innominate. It is contraindicated to introduce unnecessary rotational forces into the pregnant patient.

The proper patient placement for the adjustment is important. Referring to Chapters 6 to 11 for illustrations of the adult set-up for the cervical, thoracic, lumbar, and pelvic regions is suggested.

PELVIC BENCH

During the side posture set-up, the doctor should carefully stabilize the upper torso with a cephalic pressure, without pressing the patient’s shoulder to the pelvic bench. As the abdominal region of the pregnant patient becomes larger, the doctor must occasionally compensate the stance away from the abdomen (Fig. 14.105). In the more advanced gravid female, no body-drop during the thrust phase should occur. The patient may need to be assisted in getting off the table during the last trimester (Fig. 14.106).

HI-LO TABLE

The hi-lo table also can be used during the majority of the pregnancy. The hi-lo thoracic piece should be placed in a locked position to avoid rebounding during the thrust. As the stomach begins to protrude, the thoracic and lumbar pieces are separated to compensate for the baby (Fig. 14.107). As the thoracic section is raised, the face piece will eventually become out of reach for the patient. If this position is uncomfortable, the knee-chest table should be used.

KNEE-CHEST TABLE

The knee-chest table is very effective for adjusting the thoracic and lumbar spine in the pregnant patient (69) (Figs.

Figure 14.105. Side posture positioning of the pregnant patient.

Figure 14.106. Assisting the patient.

Figure 14.107. Pregnant patient positioning on the hi-lo table.
The proper knee-chest procedure for patient placement, indications, contraindications and thrust, are thoroughly discussed in Chapter 7. Before the thrust, it is very important that the set-up reflect the appropriate motion segment disc and facet planes in the different regions of the spine.

Figure 14.111 illustrates the proper patient placement and doctor stance for a fifth lumbar listing. A double-thumb contact can be performed on the mammillary process in the lumbar region (Fig. 14.112). Figure 14.113 demonstrates a PLS adjustment for the eighth thoracic vertebra. At no time during the thrust stage should a toggle-recoil be performed on the knee-chest table. Rather, a set and hold (approximately 2 seconds) is recommended (See Chapter 2).

In-Utero Constraint Analysis and Reduction

At the seventh month of gestation, the previously breech fetus turns itself down with the head engaged in the vertex (caudal) position of the pelvis. If the fetus remains in the breech (or other lie) position after the seventh month, biomechanical stress leading to in-utero constraint can cause extensive physical deformities and delivery complications.

Webster [5] has developed a technique to detect and correct the breech infant. Upon review of approximately 800 of his breech cases, Webster has stated that less than 25 cases did not respond to the care provided. After delivery of these unresponsive cases, other factors were determined to be related. With modifications by the author, the in-utero constraint analysis and correction are presented.

WEBSTER IN-UTERO CONSTRAINT TURNING TECHNIQUE

The first step involves placing the patient in a comfortable prone position, with the chin in a neutral position. The doctor lifts the patient’s legs bilaterally and flexes them together toward the buttocks. The purpose of this bilateral
The leg test is to determine if there is equal leg resistance. Equal leg resistance putatively indicates that the fetus is in a normal vertex position. Should the doctor discover one of the flexed legs has increased resistance (i.e., appears to push back toward the doctor), this theoretically indicates posterior sacral rotation subluxation (i.e., P-L or P-R) on the same side. Figure 14.114 illustrates increased resistance on the right leg.

The side of sacral rotation is then placed up on the pelvic bench (Fig. 14.115). The contact point of the doctor is the pisiform. This is placed between the second sacral tubercle and the posterior superior iliac spine (PSIS). The vector of thrust is from posterior to anterior (+Z) along the plane line of the articulation.

The second step involves placing the patient in a supine position. The doctor should stand on the side opposite of the sacral rotation. From this side, the doctor takes the knife edge of the inferior hand and angles it 45°
from the anterior-superior iliac spine (ASIS), lateral to medial and inferior to superior. With the superior hand, the knife edge is angled 45° from the umbilicus, medial to lateral and superior to inferior (Fig. 14.116). The intersection of both hands should be at a trigger point on the rectus abdominal muscle which is then contacted by the doctor’s thumb. If a trigger point cannot be identified, the thumb is rotated from the bisect point in either direction, until the trigger point is discovered. The thumb should be used to apply a slight superior to inferior vector, with approximately 3 to 6 ounces of pressure (Fig. 14.117). The thumb contact point is held for approximately 1 to 2 minutes, or until the doctor feels the muscle relax under the pressure contact.

After the adjustment is made, the patient is returned to the prone position and the bilateral leg test is reevaluated. In most cases, the leg resistance will equalize. If equalization is not attained, the patient is returned to the pelvic bench and the sacrum is adjusted with more depth or amplitude. After the second adjustment, the prone position is used to analyze the leg resistance. If equalization is obtained, the doctor then moves to the third step. If equalization of the legs does not occur (a rare occurrence) after the second adjustment, the doctor is advised to halt the procedure and schedule the patient for a reevaluation the following day.

No other adjustments should be performed during any visit(s) that are specifically designed to turn the intrauterine constraint infant. Clinical observations suggest that it is not unusual within three to ten visits in a 2- to 3-week time period, for positive results to occur. Equal leg resistance generally contraindicates the sacral adjustment or trigger point treatment. In rare cases, such as the complete breech and/or ventral vertex body positioning, equal resistance may be noted during the leg check. These patients should be adjusted as though a sacral base posterior is present. In addition, the trigger point contact should be made bilaterally (simultaneously).

Another rare presentation, such as the facial or brow, may require adjusting the sacral rotation as previously noted, but the trigger point contact is made on the same side of sacral rotation.

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References


