In the early 20th century, analysis of the upper cervical spine was considered the primary function of the chiropractor. Palmer (1) was so emphatic in his explanation of atlas involvement in human function that he considered it to be the link between living and dying.

Gonstead (2) took a more divergent approach than his contemporaries in describing the significance of the atlas vertebra and its putative effects on human function. He considered lesions in this area to be just as important as other spinal levels. The potential for neurologic or vascular dysfunction to occur in the upper cervical region has been the basis for its dynasty within the chiropractic and osteopathic professions.

Upper cervical subluxation may affect many different neural pathways throughout the body (3). Cole (4) studied the effects of atlas subluxation in laboratory animals. He manually produced lesions that could be confirmed with palpation. His results indicated that localized alteration in a single vertebral segment has effects which can be noted in certain organs and tissues that are innervated by the nerve supply originating in that vertebral segment. He later analyzed these effects after 96 hours and 6 weeks (5). The atlas lesion produced a primary vascular change in the tissues and organs through the activity of the autonomic nervous system. Alterations in the blood supply directly caused the tissue changes. It was also found that the parasympathetic division was involved to a greater degree than the sympathetic in the experiments in which the atlas segment was lesioned. These findings were later confirmed in experiments with 6-month follow-up (6). Although much of the preceding evidence of remote effects of upper cervical lesions is somewhat dated, it provides support for many clinical observations of apparent effects from upper cervical adjustments (7,8).

The potentially positive influence a chiropractor can have when adjustments are performed in this region must always be balanced with the harm that can be done if manipulations are of an inappropriate nature or simply contraindicated. The clinical presentation may be particularly devastating if the vertebral artery is involved.

This chapter covers the dysfunction and management of disorders affecting the upper cervical spine (i.e., C0-C2). The clinical anatomy and biomechanics of the region are discussed to facilitate understanding of this complex area. Because of the close proximity of the central portions of the nervous system (e.g., brain and spinal cord) to the osseous elements, a thorough understanding of the neurology of the area and how dysfunction can occur is required.

It is the author's experience that the C1-C2 articulation is commonly over-adjusted in the search to find "the answer" to a patient's condition. Compensatory upper cervical problems are very likely. This is primarily due to the "righting reflex" (9-12) (also known as gravitational proprioception). The presence of pain or tenderness in the upper cervical musculature could be due to lower cervical or upper thoracic subluxation creating a cervical hypolordosis or kyphosis which causes added tension in the neck extensors from anterior carriage of the head. The doctor is encouraged to use a multiparameter approach in determining the presence of an upper cervical subluxation. This will include radiologic (neutral and stressed positions), neurologic, and palpatory assessments. The doctor must be sure of the fixation component of the subluxation.

CLINICAL ANATOMY AND BIOMECHANICS

The upper cervical complex is unique in that it allows extensive motion while providing protection for the intimate neurologic and vascular structures. The articulations between occiput and atlas consist of the reciprocally curved superior facets of the lateral masses of the atlas and the ellipsoid synovial joints of the occipital bone. The superior surface of the facets of atlas are oval shaped and large in size to accommodate the occipital condyles (13,14).

The oval surfaces at C1 act as cups for the condyles to sit in, allowing primarily flexion-extension (θX) motion. A small amount of lateral flexion (θZ) and axial rotation (Y axis) is also possible.

The atlas-axis motion segment is controlled by two sets of joints. The first is between the superior facet of C2 and the inferior surface of C1, and the second is the articulation between the anterior arch of the atlas and the dens of axis. As a result of this unique arrangement, the chief motion of this region is rotation (Y axis), flexion-extension is the second major motion, followed by lateral flexion.
Ligaments

The condyles of the occiput and the superior articulating surfaces of the atlas are surrounded by fibrous capsules (Fig. 11.1). These capsules are thicker on the posterior and lateral portions, and relatively thin medially at the area where the synovial cavities interact with the bursa between the dens and the transverse ligament of the atlas.

The anterior atlanto-occipital membrane is a broad and densely woven arrangement of fibers that passes superiority through the anterior border of the foramen magnum, and inferiorly through the superior border of the anterior arch of the atlas. Anteriorly, the capsule is strengthened by the continuation of the anterior longitudinal ligament, which connects the basilar portion of the condyle to the anterior tubercle of the atlas (Fig. 11.2).

Laterally, it is continuous with the capsular ligaments (14).

The posterior atlanto-occipital membrane is a thin, broad ligament attached to the posterior border of the foramen magnum superiorly, and inferiorly to the posterior arch of the atlas. This membrane forms a border and opening (sometimes ossified) for the vertebral artery to enter and the first cervical spinal nerve to exit. Ossification of the occipital membrane (pons posterior) alone is merely an incidental finding and not a contraindication for adjustments in this region.

C1-C2

The fibrous capsules in this region are thin and loose to allow for a large range of motion. The capsules are attached to the articular margins and are lined with syno-
vial membrane. Posteriorly, each capsule is strengthened by an accessory ligament. The accessory ligament attaches to the axis at the base of the dens and to the lateral masses of the atlas. Anteriorly, these two bones are attached to each other by a continuation of the anterior longitudinal ligament (ALL). The ALL is attached at the lower portion of the anterior tubercle of atlas superiorly and to the front of the body of axis inferiorly. Posteriorly, the atlas and axis are joined together by a membrane that is attached to the lower portion of the posterior arch of atlas to the upper edges of the laminae of the axis. This membrane is a continuation of the ligamentum flavum, and on its lateral extremity it is pierced by the second cervical nerve (13,14).

The anterior surface of the dens articulates with the posterior aspect of the anterior tubercle of atlas. This articulation is surrounded by a weak and loose fibrous capsule and is lined with a synovial membrane. Posteriorly, there is a bursa between the cartilage covered anterior surface of the transverse ligament of the atlas, and the posterior grooved portion of the dens of the axis.

The transverse ligament, the most important ligament of the C0-C1-C2 complex, is a strong thick band. It is a major portion of the cruciate ligament. The transverse ligament arches across the neural ring of the atlas and holds the dens in contact with the atlas. This ligament is broader in the middle and is attached to the atlas at two small tubercles on the medial border of the lateral masses of atlas. It divides the atlas into two unequal parts; the larger posterior portion surrounds the spinal cord and its associated membranes, whereas the smaller anterior portion contains the dens. The ligament is placed in such a way that if all other surrounding ligaments are cut, the transverse ligament, by itself, will be able to keep the axis in position. Patients with rheumatoid arthritis often have disruption of this ligament, which can lead to instability (15).

CRUCIATE LIGAMENT

The cruciate ligament was given its name because of its cross-like appearance (Fig. 11.3). It has three components:

1. Transverse ligament of atlas (Fig. 11.4);
2. Caudal crus—commences at the central portion of the transverse ligament, and runs inferiorward attaching at the center of the axis posterior body; and
3. Cranial crus—commencing at the central portion of the transverse ligament, running upward to the anterior margin of the foramen magnum.

![Figure 11.3](image1.png)

**Figure 11.3.** Posterior aspect of the upper cervical articulations after removal of the posterior portion of the occipital bone and the laminae of the subjacent vertebrae. Modified from Williams PL, Warwick R. Gray’s anatomy. 36th British ed. Philadelphia: WB Saunders, 1980:449.

![Figure 11.4](image2.png)

**Figure 11.4.** Atlas with transverse ligament. Modified from Williams PL, Warwick R. Gray’s anatomy. 36th British ed. Philadelphia: WB Saunders, 1980:448.
The ligamentum nuchae attaches from the crest of the occiput to the posterior tubercle of atlas and the spinous process of the other cervical vertebrae. This ligament helps in stabilizing the skull on the cervical spine.

**ALAR LIGAMENT**

The alar ligaments, also termed the check ligaments, play a key role in controlling or checking rotation and lateral flexion at both the atlanto-axial, and occipito-atlantal joints (13,14). They are strong, round bands arising from the dens upward and lateralward, inserting into the medial borders of the condyles and atlas. In a study by Dvorak et al. (16), it was shown that severing of the alar ligament increased axial rotation at both the atlanto-axial and occipito-atlantal articulations. This increase in rotation was noted on the contralateral side of the ligament cut. The ligaments are placed on both sides of the dens symmetrically; one portion connects the dens to the atlas, and the other connects the dens to the occiput (Fig. 11.5A).

During left lateral flexion (−ΘZ), motion is controlled by the right upper portion connected to the occiput, and the left lower portion connected to the ring of atlas (11.5B). With left axial rotation (+ΘY), the movement is checked by the right alar ligament (Fig. 11.5C).

**Muscles**

The upper cervical spine, which supports the cranium from above, and a group of freely movable vertebrae below, requires an organization of musculature able to execute motion and provide stability for the area. Some of the ligamentous structures are lax in this region. Support of the head on the neck is provided primarily by the upper cervical musculature (17). Joint motion is controlled by the facet planes and their associated ligamentous structures; however, it is the responsibility of the muscles to dictate patterns of motion in the upper cervical spine and to provide much of the stability (13,14). A study by Goel et al. (17) found that relatively small loads were needed to produce large amounts of rotation at the upper cervical complex. This finding supports the idea that the ligaments of the C0-C1-C2 complex are relatively lax.

Muscle tissue has abundant nerve supply. Joint dysfunction can cause the muscles to spasm or become hypertonic (18). The spasm/hypertonicity should resolve if treatment is focused on normalizing the joint dysfunction. The finding of trigger points and myofascitis is common in the upper cervical spine. These findings are often compensatory for disturbances below.

Flaccidity of the muscles will place more stress on the ligaments, possibly leading to ligament laxity and instability. Treatment protocols that focus solely on the muscles can lead to inappropriate management. Although muscles can be a source of pain, they should not be the only focus of a treatment paradigm. The use of trigger point therapy and transverse frictional massage would be indicated when fibrotic adhesions have developed in the area. Passive mobilization is encouraged after acute neck injuries (See Chapter 10).

Clinical observations suggest that individuals who have sustained soft tissue injuries respond quickly to treatment if they are well conditioned and have good muscle tone, provided all other variables are equal.

Once articular function has been restored, the use of exercises to help strengthen the associated muscular elements is strongly recommended. Posttraumatic muscle weakness, secondary to scar tissue or nerve damage, and joint weakness caused by creep of ligamentous structures may improve with specific exercises. The main purpose of these exercises is to stretch muscle and fascial elements that have been shortened and to contract muscles that have been in a chronic state of relaxation or hypotonicity. The patient should avoid movements that are in the direction of ligamentous sprain.
Patterns of Motion

FLEXION-EXTENSION ±θX

Flexion at C0-C1-C2 is limited by a bursa that originates from the condyles and inserts into the dens of axis. It is referred to as the bursa apicus dentis. Extension at this joint is limited by the tectorial membrane which is a continuation of the posterior longitudinal ligament. Flexion-extension in this region is approximately 25° at the C0-C1 articulation and 20° at C1-C2 (13).

LATERAL FLEXION ±θZ

The amount of lateral flexion allowed at both C0-C1 and C1-C2 is approximately 5° to either side (13). This motion is controlled by both components of the alar ligaments. During lateral flexion, there is a slight ipsilateral translation of the atlas (±X) to the side of the bend (viewed with stress radiography). Presence of this motion may contraindicate lateral to medial adjutistic thrusts from the contralateral side.

ROTATION ±θY

Rotation in the upper cervical complex is approximately 40° at C1-C2, and 5° at C0-C1 (13). This movement is controlled by the alar ligaments. For example, rotation to the right is controlled by the left alar ligament, and vice versa.

Neurology

Because of the anatomic relationship of the atlas and occiput with the brain stem, subluxation in this area may affect a variety of neural structures; cervical spinal cord, first and second cervical spinal nerves, superior cervical ganglion, and cranial nerves X, XI, XII. This region should not be overlooked as a potential cause of a variety of neurodysfunctional states. Experimental lesions in laboratory animals (3–6) have shown effects predominantly on the parasympathetic division of the autonomic nervous system. Clinical studies by Harris and Wagon (19) demonstrated nonsympathetic effects on distal skin temperature when the patient was adjusted in the upper cervical spine. Gonstead (20) associated adjustments of the upper cervical spine (i.e., C0-C5) with effects primarily in the parasympathetic division.

It takes an average of 64° of rotation (Y axis) at the atlanto-axial articulation before the size of the neural canal is reduced to a diameter of 1 cm. The canal is 3 cm in width. One centimeter is taken up by the axis, 1 cm by the cord, and one-third is free space. An average of 63° of rotation is required to cause bilateral facet dislocation of the atlanto-axial articulation (21). Thus, direct cord compression due entirely to rotation of the bony elements appears unlikely. The models for dysfunction in the upper cervical region are very complex. Because of the proximity of the cervical sympathetic chain, the vagus, the various connective tissues and the cerebral spinal fluid, subluxation complexes are likely to have multiple neurologic effects.

When immobilization is present due to misalignment (positional dyskinesia), changes in the architecture of the connective tissue and the neuroreceptors occur (22). This contracture and constriction of the connective tissue will tighten the collagen matrix, thus putting more stress on the sensory receptors. As a result, slight movement will be perceived by the receptors as gross alterations in the joint. This abnormal sensory input can cause hyperactivity at the sensory receptor level feeding into the reflex pattern. This could be one reason changes in posture and nerve function have been observed after adjustments of the upper cervical spine.

Inflammation as a result of immobilization may cause hyperexcitability of nerves, particularly the dorsal root ganglia and spinal nerve roots. Inflammatory responses after trauma, disc herniation or end-plate fracture (Schmorl’s node) may cause damage to the recurrent meningeal nerves, dorsal root ganglia, or spinal nerve roots (22).

Grostic (23) has proposed that the dentate ligament may be able to distort the cervical spinal cord from mechanical tensions in the area. The size and strength of the dentate ligaments indicate that they have a restaining function on the cord and restrict vertical movement. Combined with positional dyskinesia of the upper cervical region, the ligaments could traction different portions of the cord, thus leading to ischemia or direct mechanical irritation.

MECHANORECEPTORS

Mechanoreceptors within the upper cervical area play a key role in movement control and postural adaptations. They are divided into three types.

Type 1 mechanoreceptors are located in the stratum fibrosum of the capsules and ligaments. They are more dense in the proximal joints and are active both at rest and in movement. These receptors play an important role in positional sense, as they signal the angle of the joint throughout the range of motion (11,24,25).

Type 2 mechanoreceptors reside at the junction of the synovial joints and the fibrosum of the capsules. At the distal joints, they are high in density and are active at the beginning and termination of movement and adapt quickly to sudden movements. These receptors can also be found in the intraarticular and extraarticular fat pads.

Type 3 mechanoreceptors are located in the collateral ligaments. They adapt slowly and are active at the end of joint ranges.
There are also pain and proprioceptive fibers in the upper cervical area that communicate with the brain via a branch of the second cervical nerve or the greater occipital nerve.

Vertebral subluxation complex in the upper cervical region may influence posture via joint fixation and reflex compensatory mechanisms. In the past, it was hypothesized that such symptoms as vertigo, dizziness, and equilibrium disorders were either vascular or brainstem related. Recent literature indicates that mechanoreceptor injury can duplicate these symptom patterns.

Korr (18) states that the joint receptors in the capsules and ligaments send signals that inform the higher centers regarding joint angles, velocity, and direction of joint movement. Muscle spindle fibers are arranged in parallel, located within the muscle, and attached at both ends. These intrafusal fibers are innervated by gamma motor neurons that originate from the ventral horn and pass through the ventral root. The function of these fibers is to control contraction of the intrafusal fibers and through them, the sensitivity of the spindles. When a spindle fiber is slackened during muscle shortening, the spindle charge is reduced; and if a muscle is contracted, the discharge is increased. The term gain is used to explain the activity of the gamma fibers as their activity increases or decreases to maintain an average, even muscle tone. In the presence of a “lesion,” the gain levels have been “stuck” on high settings (18). That is, the gamma discharge to the intrafusal fibers has increased, which keeps the fibers in a shortened state and the spindles highly sensitive. The spindle will be continually discharging because of the influence of gravitational forces and postural reflexes in an effort to stretch the muscle back toward its resting length. However, because the CNS is ordering the muscle to resist, the more the stretch, the greater the resistance. Theoretically, manipulative procedures may be able to reset the spindle gain (18).

**Vertebral Artery**

Selecki (21) studied the effect of rotation on the vertebral arteries that exit from the foramina of the atlas and course their way down the cervical spine. He found that after 30° of rotation, the vertebral artery on the contralateral side was kinked and stretched. This phenomenon occurred at the level of the foramen transversarii. At 45° of rotation the ipsilateral artery was also kinked. If both arteries are impinged, this may cause symptoms similar to stroke or TIA, such as nausea, vomiting, and visual disturbances. If only one vertebral artery is present, rotation to one side can cause vascular incompetence. Activities such as overhead work or stretching exercises of the neck may also produce circulatory symptomatology.

There have been several cases reported of Wallenberg’s syndrome, as a result of rotational manipulations of the cervical spine (26–46). Stroke or stroke-like symp-

toms can occur in patients as a result of rotatory type manipulations, regardless if the patient has preexisting symptoms. Manipulative type procedures implicated in causing vascular accidents are not limited to the practice of chiropractic. Clearly, the need for rotary manipulations of the upper cervical spine is questionable, because a variety of alternate techniques are available without the associated morbidity (2,32).

The cervical adjustments advocated here involve a minimal amount of axial rotation (if any), which significantly reduces the possibility of causing vertebral artery injury. Different head positions will influence the extent of cerebral circulation. The position of the patient’s head and neck before (i.e., set-up) and during an adjustment should maximize the patency of the vertebral arteries, i.e., avoidance of extension with rotation (Fig. 11.6).

**UPPER CERVICAL DISORDERS**

**Vertigo**

Vertigo as a result of upper cervical joint dysfunction has been generally accepted. In a study by Fitz-Ritson (47), 90.2% of a group of patients became symptom free after an average of 18 chiropractic treatments. Those patients that achieved the best results had suffered from acute upper cervical joint problems.

Vertigo seems to be present in large numbers of patients involved in whiplash-type injuries. Hinoki (48,49) reports that of his patients who were involved in whiplash injuries, 87% suffered from vertigo. The trauma that is introduced to the spine damages the proprioceptors of the muscles, joints, and tendons. Brunarski (50) states that the cervical proprioceptive input tends to overcompensate via somatosensory projection. Thus, cervicogenic vertigo is both a causative factor and an effect of autonomic dysfunction.

**Atlanto-axial Rotary Fixation/Subluxation**

Atlanto-axial rotatory fixation (AARF) is poorly understood, although it is well documented in the literature (51–55). This condition primarily occurs in children and is associated with torticollis. At times, it has been noted as a sequela to cerebral infection, upper respiratory tract infection, or trauma. It is assumed that the disorder is caused by an increased laxity of the alar, capsular, and transverse ligaments. Children that have been diagnosed with this condition usually present with torticollis and decreased cervical range of motion. There may or may not be pain.

Altongy and Fielding (53) state that the reason most of these cases are delayed in diagnosis is because of the difficulty in obtaining a quality radiograph. This is due to the position of the patient’s neck (rotation and lateral flexion).

Classic clinical features include the “cock robin” posi-
tion in which the head is laterally flexed to one side, rotated toward the opposite side, combined with slight flexion. Patients will usually have no neurologic signs; however, the greater occipital nerve may be irritated because it emerges between C1-C2 (54). Dvorak’s maneuver (see Chapter 4) is usually positive, because 50% of the rotation of the cervical spine occurs at C1-C2. Motion palpation can also be used to compare the rotational and lateral flexion motions of the atlas on axis.

Radiographically, AARF can be diagnosed with the use of the antero-posterior open mouth, by checking for a persistently asymmetrical relationship of the articular masses of the atlas with the dens. Lateral bending radiographs are useful for determining the pattern of thrust for the adjustment. Cineradiography can be used if positioning is difficult. On rotation, the axis and the posterior arch of atlas move as one unit. Flexion/extension views assist in ruling out antero-posterior displacement. Lateral displacement of the dens in relation to atlas by more than 4 mm suggests AARF (54).

AARF is classified into two categories: type 1 and type 2. In type 1, anterior rotation fixation is present on one side of C1-C2 with no dislocation. This is seen in both adults and children. For type 2, there is anterior dislocation of one lateral mass of C1 on C2 along with interlocking of the facets. This has been reported only in children and is associated with trauma. Orthopaedic treatment usually consists of halter traction for a period of two to three weeks during the acute stage. If progress is not satisfactory, surgery is performed (e.g., atlanto-axial, occipito-atlantal, or occipito-atlanto-axial arthrodesis).

Altongan (53) reports a case of a 9-year-old boy who presented with a 2-month history of neck pain and stiffness as a result of injuries sustained while break-dancing. Initial examination revealed decreased cervical spine range of motion with pain. No neurologic deficits were noted. Symptoms and physical findings were consistent with AARF. Radiographic findings confirmed AARF and the patient was admitted to the hospital. CT scan demonstrated a rotatory subluxation of the occiput on atlas.
and atlas on axis. Approximately 3½ weeks of traction ranging from 3.2 to 5.5 kilograms did not seem to resolve the problem. Post CT scan demonstrated some improvement of the subluxation but not complete reduction. At that point, a posterior atlanto-axial arthrodesis was performed during which “no gross malrotation could be appreciated through the exposure.” A halo vest was applied and was worn for 6 weeks until fusion was solid. After 3 months, the brace was removed, and the child was able to rotate the head 45° bilaterally without pain. Thirty-six months after the operation, the patient had 70° of rotation bilaterally and no evidence of recurrence.

The chiropractic approach to AARF is much less drastic. The relative efficacy of any treatment remains unknown. When a patient presents with AARF, a complete examination of the upper cervical spine should be performed (See Chapters 4 and 5). Flexion-extension, standing AP and lateral views, and lateral bending radiographs, should be analyzed. If type 2 AARF has been ruled out, specific adjustments can be used to restore normal mechanical function by reducing the fixation dysfunction. Stretching exercises can be used to relax muscle hypertonicity. If after 2 to 3 weeks (i.e., several treatments), there has been no change in symptomatology, then a less conservative approach, such as halter traction, may be used. If surgery is performed (usually arthrodesis), adjustments at that level are contraindicated. The chiropractor can adjust above or below the fused areas, if indicated. A better understanding of AARF should open more avenues for treatment of this condition. Research in this area should be a high priority for the chiropractic profession.

**Transverse Ligament Rupture**

Bueller (56) describes anterior atlanto-axial subluxation (AAS) and various disorders that can arise as a result of this disturbance. The doctor must rule out the presence of AAS if certain objective and subjective signs such as headache, transient quadriplegia, neck weakness, or vertigo are present. Measurement of the atlanto-dental interval (ADI) (See Chapter 5) will help detect the amount of misalignment and spinal cord compromise. Standard lateral cervical views taken at 72 in. are analyzed to measure the ADI. Hinck and Hopkins (57) use the following formula to determine the normal ADI. They measure the inferior portion of the ADI and apply the following:

- Male: $2.052 - (0.0192 \times \text{age in years}) \pm 1.0 \text{ mm}$
- Female: $1.238 - (0.0074 \times \text{age in years}) \pm 0.9 \text{ mm}$

They also state that the average normal measurement for children is 2.0 to 2.5 mm in extension, and 2.0 to 3.0 mm in flexion. If in adults a minute increase in the space is seen (4–5 mm), it is most likely caused by transverse ligament laxity.

The “V” sign (13), which often resembles a normal variant may be present in cases after significant trauma. This is indicative of a partial rupture or stretch of the transverse ligament (Fig. 11.7A-C). Fielding et al. (58) first reported this sign in 1974, interpreting it as a rupture of all the fibers of the transverse ligament except the lower fibers. This condition has not been proven to be clinically stable (13). Etiology of AAS can be classified into two categories:

1. Tearing or laxity caused by trauma.
2. Involvement of the dens as a result of trauma; erosions, resorptions, or congenital malformations.

Without bone damage, there are few cases in which the transverse ligament has ruptured and caused anterior displacement of the atlas on axis (59,60). The transverse ligament is quite strong and it is usually the odontoid that will break first during trauma. Instances in which rupture
of the transverse ligament could be noted without dens fracture or other traumatic insult include:

1. Rheumatoid arthritis (61).
2. Yersinia arthritis (62).
3. Reiter's syndrome (63).
4. Down's syndrome (64); 10 to 20% of individuals with this genetic disease process show lack of or laxity of this ligament.
5. Ankylosing spondylitis (65).
6. Osseous metastasis, tuberculosis (65).
7. Psoriatic arthritis (66).

If severe AAS is suspected or evident, orthopaedic referral is necessary to determine the need for fusion. Lack of symptomatology still necessitates immediate referral, because fusion of the separation could prevent further potentially life-threatening injury.

Fracture

When a patient presents for examination and treatment after trauma, the upper cervical region should be scrutinized for the possibility of fracture or dislocation. Fractures or dislocations in this area can be neurologically or biomechanically unstable (See Chapter 12).

EXAMINATION (C1-C2)

The atlas is often in a compensatory position when analyzed in the coronal plane, due to the righting reflex. Because of this effect, it is necessary to rely on more than apparent radiographic findings to arrive at a differential diagnosis. Equally undesirable is to equate muscle bulging over the transverse process, or taut and tender muscle fibers, as pathognomonic of subluxation. A multiparameter examination is necessary. Examination of the upper cervical spine is generally performed with the patient in the seated position.

Static Palpation

Static palpation is used to detect edema or “bogginess” caused by tissue injury. This may be a result of direct trauma or autonomic nervous system effects. Static axial rotation of C1 can be palpated as an increased muscle/tissue bulging on the side of posterior rotation. Malformations and muscular asymmetries lessen the validity of this procedure.

Motion Palpation

Motion palpation involves examining the movement of atlas with respect to axis. It should not be relied on solely for the listing; however, motion palpation can be used to determine the presence of fixation dysfunction. The AS or AI component of the listing is best determined by analyzing the lateral radiograph, rather than relying on motion palpation.

ROTATION ± Ψ Y

Because the primary movement of C1-C2 is rotation (Y axis), fixation dysfunction can be readily determined. The doctor should rotate the patient's head from side to side. The atlas will rotate less on the side of fixation. Dvorak’s maneuver (See Chapter 4) is used for determining upper cervical rotational fixation. As the patient's head is flexed and rotated, the upper cervical spine is isolated. By comparing motion bilaterally, the direction of fixation is determined.

LATERAL FLEXION ± Ψ Z

The doctor’s segmental contact point is the transverse process of atlas between atlas and axis with either the thumb or the finger tips. If the doctor’s hands cannot reach around the neck, the joint can be analyzed unilaterally. As the patient’s head is bent from side to side, the motion of the segment is analyzed. The notion that the atlas compresses on the side of lateral flexion is questionable. The lateral mass of C1 most likely raises on the contralateral side of bend when C1 is laterally flexed on C2. The doctor, therefore, feels for the lack of motion on the contralateral side of fixation when the head is laterally flexed from side to side.

Instrumentation

Instrumentation (e.g., nervoscope) can also be used as part of the examination. During scanning, the instrument should be glided caudad to cephalad. The most common false-positive finding the doctor may encounter is due to suboccipital hair. Because of the close proximity of the articulations (i.e., C0-C2), it is difficult to determine which segmental level is involved when a true positive is present.

Inspection

Inspection is also used to derive the listing. If the atlas rotates anteriorly, there may be head tilt ipsilaterally. When the atlas rotates posterior (e.g., ASRP), there may be superficial muscle bulging on the side of posteriority. Lateral flexion malposition will also cause a slight head tilt, especially if the patient's eyes stay closed during the examination.

George's Test

George's test is performed to rule out vertebro-basilar artery insufficiency. It has historically been used to determine whether or not manipulation of the cervical spine is contraindicated. This test can, however, have a number of false positives that provide contradicting information; therefore, it should not be relied on exclusively to determine if an adjustment is contraindicated.
The test that is commonly used for detection of vertebral artery insufficiency (VBI) (67) is cervical rotation with extension. The patient’s head should be put in maximal rotation and extension for a minimum of 10 seconds. The patient is asked if any unusual sensations such as nausea, or blinking lights are noticed. Vertebral artery occlusion may be reduced on the contralateral side of rotation; however, there can be occlusion of the ipsilateral artery with the presence of osteophytes. Patients are categorized as follows (67):

Type 1 patients show signs of vertigo, visual disturbances, motor/sensory symptoms.

Type 2 will have occasional dizziness, or mild transient symptoms.

Type 3 patients experience no symptoms that would be indicative of VBI.

Type 2 and 3 patients may be safely adjusted. Type 1 patients need not be classified as “non-adjustable.” Ferrezy (26) states that by normalizing the biomechanical function, the doctor may be preventing other ischemic attacks from arising. Of course, rotational type manipulations would be contraindicated.

Radiographic Analysis

When analyzing the radiograph, it is important not only to evaluate the specific segment in question but also the adjacent motion segments that may react in compensation to the involved level. Because the atlas rotates around the odontoid process of the axis, it is used as the point of reference.

First, the lateral cervical radiograph is used to help analyze the positional relationship between C1-C2. The odontoid process will be represented by a line that traverses it longitudinally. Two dots are placed, one in the center of the base of the odontoid and another so it bisects the odontoid near its superior margin. The line drawn through these points is called the odontoid line (Fig. 11.8).

A line drawn perpendicular to the odontoid line is placed through the middle portion of the axis body, termed the odontoid perpendicular line.

The AP atlas plane line is drawn by placing two dots on the atlas, one in the center of the anterior tubercle, and the other in the center of the intersection of the posterior arch with the posterior tubercle. If the patient’s head is tilted, so that one side of the arch no longer completely overlaps the other, the dot should be placed in the middle of the broadened image of the arch, or in the center of the space formed between the two sides of the posterior ring (2). When the atlas and axis have relatively normal alignment, the AP atlas plane line and the odontoid perpendicular line are parallel. Slight variances of this relationship, especially extension of the atlas on axis, are not considered significant, unless accompanied by other clinical findings.

When viewing the atlas-axis relationship on the AP radiograph, optimal alignment will be depicted by lines that are parallel, providing there are no structural anomalies. The line that represents the plane of the axis is termed the “axis plane line.” The plane of the atlas is represented by a line termed the “atlas plane line,” which is drawn through like points on either side of the atlas, the most reliable of which are the transverse process-lateral mass junctions. These are the points where the superior and inferior borders of the transverse processes join the lateral masses. Because the superior borders of the transverse processes are often obscured by the overhanging occiput, the point where the inferior border joins the lateral mass is usually selected. When the atlas transverse plane line and the axis plane line appear parallel on the AP radiograph, the atlas and axis are considered to be in relatively normal alignment.

ANTERIOR (+Z) POSITIONAL DYSKINESIA

Because the transverse ligament keeps the atlas close to axis, anteriorward displacement is rare, unless there is ligamentous rupture. It has been stated that the first letter in the listing is “A” because of the anterior slippage of the atlas on the axis (2). It is probably more accurate to state that the atlas rotates around the X axis, and while doing so it may slide anteriorward. If indeed, anteriority is present, and is a factor in the subluxation, it would be difficult to detect on the lateral radiograph unless the transverse ligament were torn or stretched. When contacting the atlas transverse process for an adjustment, the antero-lateral portion is used (Fig 11.9).

SUPERIORITY/INFERIORITY ± (X)

Superiority and inferiority (±θX) of the anterior tubercle can be detected radiographically. Hyperextension displacement is more common than hyperflexion positional
dyskinesia. This misalignment (−θX) is best seen on the lateral radiograph. The AP atlas plane line and the odontoid perpendicular line will diverge anteriorly. The other possible direction of misalignment is inferiorward (+θX). Although uncommon, it should not be overlooked. This misalignment is also best detected with the lateral radiograph. The AP atlas plane line and the odontoid perpendicular line converge anteriorly with this positional dyskinesia.

If the line drawings on the lateral radiograph indicate that the misalignment is in a superior direction, the letter “S” is placed with the letter A, and if the lines indicate that the misalignment is in the inferior direction, the letter “I” is placed next to the letter A (Fig. 11.10A-B). At this point the listing of the atlas will either be AS or AI.

Another radiographic finding that should be checked for when analyzing the atlas is the space between the posterior portion of the anterior tubercle of atlas and the anterior portion of the dens. In the AS listing, an inverted “V” will be seen in that space. With the AI listing, there will be the appearance of a “V”.

Whether the introduction of a torque (±θX) during the adjustment actually corrects the superiority or inferiority component remains to be seen.

LATERALITY ±θZ (±X)

It has been thought in the past that as the atlas subluxates, it shifts laterally. What likely happens, however, is that as it rotates around the z axis, it may move toward the convexity of lateral bend. The use of the AP radiograph appears to be the more reliable method to determine this displacement. Because of the superior lift of atlas on the side of lateral shift, a wedging of the axis plane line and the atlas transverse plane line will be evident. When the atlas misaligns laterally to the left, a diverging of these two lines occurs (Fig. 11.11) and the letter “L” is added to the listing. Possible listings include ASR, ASL.

ROTATION ±θY

Rotation is the fourth letter of the atlas listing, and may be determined by using the AP radiograph. The size of the

![Figure 11.10.](image)


![Figure 11.11.](image)

**Figure 11.11.** Radiograph demonstrating right lateral flexion positional dyskinesia (e.g., ASL).
indented concave surfaces of the lateral masses can be used to analyze for rotation. Because the upper medial surfaces of the lateral masses are concave and indented, they will appear as a radiolucency within the lateral mass. The side of anterior rotation will show a wider area of lucency, and posterior rotation will demonstrate a narrower area of radiolucency.

In Table 11.1 the majority of positional configurations that can occur are presented. Displacements in parenthesis will have equivocal or absent radiograph findings. The pattern of thrust is also provided.

**ADJUSTMENT (C1-C2)**

The seated upper cervical adjustment can be used to address multiple components of the atlas listing. AI atlas listings may be corrected in the prone or side lying position or adjusted in the cervical chair. The knee chest and hi-lo are considered alternate tables for adjusting AS listings. To reiterate, whether or not the torque ($\pm \theta X$) actually does correct the superiority of the subluxation remains to be seen. Its application does, however, appear to increase the acceleration and "smoothness" or fluidity of the adjustment.

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**Name of technique:** Gonstead

**Name of technique procedure:** ASR ($+Z, -\theta X, -\theta Z, -X$) atlas adjustment (Fig. 11.15A).

**Indications:** Antero-superior translation ($-\theta X$), lateral flexion to the left ($-\theta Z$) (Fig. 11.15B). Flexion and right lateral flexion fixation dysfunction.
### Table 11.1.
The Atlas Listings

<table>
<thead>
<tr>
<th>Goniometric Listing</th>
<th>International</th>
<th>Pattern of Thrust</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASR</td>
<td>$(+Z), -\theta X, -\theta Z, (-X)$</td>
<td>Right to left, through the C1-C2 joint plane line, inferior arcing motion toward the end of the thrust.</td>
</tr>
<tr>
<td>ASRA</td>
<td>$(+Z), -\theta X, -\theta Z, -X, +\theta Y$</td>
<td>Right to left through the C1-C2 joint plane line, the head is rotated toward side of contact, an inferior arcing motion toward the end of thrust.</td>
</tr>
<tr>
<td>ASRP</td>
<td>$(+Z), -\theta X, -\theta Z, (-X), -\theta Y$</td>
<td>Right to left, through the C1-C2 joint plane line, the patient's head is rotated away from the side of contact, an inferior arcing motion toward end of thrust.</td>
</tr>
<tr>
<td>ASL</td>
<td>$(+Z), -\theta X, +\theta Z, (+X)$</td>
<td>Left to right, through the C1-C2 joint plane line, an inferior arcing motion toward the end of the thrust.</td>
</tr>
<tr>
<td>ASLA</td>
<td>$(+Z), -\theta X, +\theta Z, (+X), -\theta Y$</td>
<td>Left to right, through the C1-C2 joint plane line, the head is rotated toward the side of contact, an inferior arcing motion toward the end of the thrust.</td>
</tr>
<tr>
<td>AIR</td>
<td>$(+Z), +\theta X, -\theta Z, (-X)$</td>
<td>Right to left, through the C1-C2 joint plane line, a superior arcing motion toward the end of the thrust.</td>
</tr>
<tr>
<td>AIRA</td>
<td>$(+Z), +\theta X, -\theta Z, -X, +\theta Y$</td>
<td>Right to left, through the C1-C2 joint plane line, the head is rotated toward the side of contact, a superior arcing motion toward the end of the thrust.</td>
</tr>
<tr>
<td>AIRP</td>
<td>$(+Z), +\theta X, -\theta Z, (-X), -\theta Y$</td>
<td>Right to left, through the C1-C2 joint plane line, the head is rotated from the side of contact, a superior arcing motion toward the end of the thrust.</td>
</tr>
<tr>
<td>AIL</td>
<td>$(+Z), +\theta X, +\theta Z, (+X)$</td>
<td>Left to right, through the C1-C2 joint plane line, a superior arcing motion toward the end of the thrust.</td>
</tr>
<tr>
<td>AILA</td>
<td>$(+Z), +\theta X, +\theta Z, (+X), -\theta Y$</td>
<td>Left to right, through the C1-C2 joint plane line, the head is rotated toward the side of contact, a superior arcing motion toward the end of the thrust.</td>
</tr>
<tr>
<td>ASLP</td>
<td>$(+Z), -\theta X, +\theta Z, (+X), +\theta Y$</td>
<td>Left to right, through C1-C2 joint plane line, the head is rotated away from the side of contact, an inferior arcing motion toward the end of the thrust.</td>
</tr>
</tbody>
</table>

---

**Figure 11.15.**  
Contraindications: All other listings, normal FSU, hypermobility, instability, destruction of atlas, pathologic fracture of the neural arch, infection of the contact vertebra, transverse ligament rupture, C1-C2 arthrodesis.

Patient position: Seated in the cervical chair. The stabilization strap should be placed over the left shoulder.

Doctor’s position: Standing behind the patient, favoring the right side.

Contact point: Tip of the right thumb. Segmentally, the anterolateral portion of the atlas transverse process.

Supporting hand: The left hand is used to stabilize the C2-C3 articulation on the opposite side (cupping the hand over the ear).

Pattern of thrust: Lateral to medial, through the C1-C2 joint plane line along with an inferiorward arcing motion toward the end of the thrust.

Category by algorithm: Short lever specific contact procedure.

rotation to minimize excessive rotation of the cervical spine.

Figure 11.16. A, AIRA atlas adjustment. B, Radiograph of an AI atlas (lateral view). C, To avoid rotation in the cervical spine with the patient in the prone position, the torso is rotated to the side of head.

D, Patient positioning on the knee-chest table for an AI atlas. The arm is raised to reduce tension in the cervical spine.

Name of technique: Gonstead

Name of technique procedure: AIRA (+Z, +θX, −θZ, −X, +θY) atlas adjustment, modified toggle (Fig. 11.16A).

Indications: Extension, right lateral flexion, and right anterior rotation fixation. Antero-inferior translation (+θX, +Z) (Fig. 11.16B), left lateral flexion (−θZ), and left axial rotation (−θY) positional dyskinesia.

Contraindications: All other listings, normal FSU, hypermobility, instability, destruction of the atlas, or pathologic fracture of the neural arch, infection of the contact vertebra, transverse ligament rupture, C1-C2 arthrodesis, vertebral artery insufficiency.

Patient position: Prone on the knee-chest or hi-lo table (Fig. 11.16C), with the head rotated to the right. The right arm may be brought up by the head to help relax the paraspinal musculature (Fig. 11.16D).

Doctor’s position: Facing perpendicular to the patient, with a slight angulation away from the patient to push anterior to posterior for correction of axial rotation.
Contact point: Soft pisiform of the inferior hand. Segmentally, the antero-lateral portion of the transverse process of atlas.

Supporting hand: The superior hand will wrap around the inferior hand (single hand contact).

Pattern of thrust: Lateral to medial, through the C1-C2 joint plane line, along with a superiorward ($-\theta_X$) torque motion toward the end of the thrust.

Category by algorithm: Short lever specific contact procedure.

Name of technique: Gonstead

Name of technique procedure: ASRP ($+Z, -\theta_X, -\theta_Z, -X, -\theta_Y$) atlas adjustment (Fig. 11.17).

Indications: Flexion, right lateral flexion, and left axial rotation fixation. Antero-superior ($+Z, -\theta_X$) lateral flexion ($-\theta_Z$), and right axial rotational ($-\theta_Y$) positional dyskinesia.

Contraindications: All other listings, normal FSU, hypermobility, instability, destruction of the atlas, or pathologic fracture of the neural arch, infection of the contact vertebra, transverse ligament rupture, C1-C2 arthrodensis.

Patient position: Seated in the cervical chair. The stabilization strap should be placed over the left shoulder. The head is rotated away from the side of contact proportional to the rotational ($Y$ axis) component of the listing. If VBAI is present, there should be no axial rotation.

Doctor’s position: Standing behind the patient, favoring the right side.

Contact point: Tip of the right thumb. Segmentally, the antero-lateral portion of atlas transverse process.

Supporting hand: The left hand is used to stabilize the C2-C3 articulation on the opposite side (cupping the hand over the ear).

Pattern of thrust: Lateral to medial, through the C1-C2 joint plane line, along with an inferiorward arcing motion at the end of the thrust.

Category by algorithm: Short lever specific contact procedure.

Name of technique: Gonstead

Name of technique procedure: ASL ($+Z, -\theta_X, +\theta_Z, +X$) atlas adjustment (Fig 11.18A).

Indications: Flexion fixation, left lateral flexion fixation. Antero-superior translation ($-\theta_X$), right lateral flexion ($+\theta_Z$) positional dyskinesia.

Figure 11.17. ASRP atlas adjustment.

Figure 11.18. A, ASLA atlas adjustment. The head is turned toward the side of contact to correct the anterior rotation. B, Stabilization for the atlas adjustment.
Contraindications: All other listings, normal FSU, hypermobility, instability, destruction of the atlas, infection of the contact vertebra, transverse ligament rupture, C1-C2 arthrodensis.

Patient position: Seated in the cervical chair. The stabilization strap should be placed over the right shoulder.

Doctor's position: Standing behind the patient, favoring the left side.

Contact point: Tip of the left thumb. Segmentally, the antero-lateral portion of the left transverse process of the atlas.

Supporting hand: The right hand is used to stabilize the C2-C3 articulation on the opposite side (cupping the hand over the ear) (Fig. 11.18B).

Pattern of thrust: Lateral to medial, through the C1-C2 joint plane line, along with an inferiorward arcing motion toward the end of the thrust.

Category by algorithm: Short lever specific contact procedure.

EXAMINATION (C0-C1)

The condyle should be analyzed in relation to the atlas. Because of the close proximity of the C0-C1 and C1-C2 joints, it is easy to misinterpret the examination findings. Therefore, extra attention is advised when examining this area. As with C1-C2, all methods of examination discussed should be used (i.e., static palpation, motion palpation, instrumentation, and radiography).

Static Palpation

Static palpation at C0-C1 is used to detect edema and bogginess caused by tissue injury. Muscle and soft tissue bulging may also be palpated on the side of posterior rotation.

Motion Palpation

Motion palpation is primarily used to analyze flexion and extension motion. This is done by contacting the condyle with the fingertips while the patient's head is moved around the X axis. With a PS condyle fixation, extension will be limited.

Instrumentation

Instrumentation (e.g., Nervoscope) can be used in the same manner as when examining C1-C2. Suboccipital hair is likely to give spurious findings.

Inspection

Inspection is limited, but it can be used to derive the listing. The doctor may find a head tilt with associated positional dyskinesia of the occiput in lateral flexion.

Radiographic Analysis

The neutral upright posture of the occiput or foramen magnum should create maximal patency for the spinal canal. For this to occur, the foramen magnum line is relatively parallel to the AP atlas plane line (Fig. 11.19). Because of the difficulty in identifying landmarks for the foramen magnum line, a qualitative inspection of the region is generally performed. Both hyperextension and hyperflexion of the joint is considered abnormal. These findings must then be correlated with stress radiographic and clinical assessments.

AS (−θX), PS (+θX)

The condyles may move anterior and superior "AS" or posterior-superior "PS" in relation to the atlas. With anterior glide, the AP foramen line and the AP atlas line will converge posteriorly (Fig. 11.20A). The space between the posterior arch of atlas and the foramen magnum is reduced. With the PS misalignment, the two lines will converge anteriorly, and the space between the foramen magnum and the posterior arch of atlas is increased (Fig. 11.20B). Stress radiography, with the patient in maximum flexion and extension, can be used to determine if the positional dyskinesia noted on the neutral lateral radiograph is also fixed.

RS (−θZ), LS (+θZ)

Lateral flexion positional dyskinesia is determined with the AP radiograph. The transverse condyle line is used to determine the displacement. This line is drawn through like points on both sides of the condyles. The points that can be used are the mastoid notches (grooves on the mastoid process of the temporal bones). When like points have been determined and the lines have been drawn, optimal alignment in the coronal plane is assumed if the lines are parallel.

![Figure 11.19. Relatively normal alignment of C0-C1. Modified from Herbst RW. Gonstead chiropractic science and art. Mt. Horeb, WI: Sci-Chi Publications, 1968:133.](image-url)
With misalignment, the atlas transverse plane line and the transverse condyle line will diverge. If lateral flexion is to the left, then a RS (right superior) listing is assigned.

**AXIAL ROTATION (Y AXIS)**

Rotation is indirectly analyzed from the radiograph. Because of the atlas' ability to compensate in axial rotation, its rotation is used to determine rotation at the condyle. If the lateral mass of the atlas is wider (anterior), on the side of the condyle involvement, the condyle is listed as posterior, and vice versa (Fig. 11.21).

**ADJUSTMENT (C0-C1)**

Condyle adjustments are performed in the seated position. Alternate moves can be performed either supine, or prone on the knee-chest or hi-lo table. The knee-chest PS condyle adjustment is considered the second option for patient positioning. Descriptions of the listing components and the patterns of thrust for their correction are presented in Table 11.2.

The doctor’s contact point for a PS listing is the thenar pad (Fig. 11.22A-B). First, a superior glide is taken with the contact hand to displace excess occipital hair (Fig. 11.23A). The hand is then slid down as the proximal portion of the thenar pad hooks the supramastoid groove (Fig. 11.23B).

---

**Name of technique: Gonstead**

**Name of technique procedure: PSRS (+θX, -θZ) condyle adjustment (Fig. 11.24).**

**Indications:** Extension fixation, right lateral flexion fixation. Postero-superior glide (+θX, -Z), left lateral flexion (-θZ) positional dyskinesia.

**Contraindications:** All other listings, normal FSU, hypermobility, instability, destruction of the condyle, or pathologic/nonpathologic fracture of the condyle, infection of the contact bone, C0-C1 arthrodesis.

**Patient position:** The patient is seated in the cervical chair. The stabilization strap is placed over the left shoulder.

**Doctor’s position:** Behind the patient, favoring the right side.

**Contact point:** Thenar pad of the right hand over the patient’s right supramastoid groove.

**Supporting hand:** The left hand is used to stabilize the C1-C2 articulation on the opposite side.

**Pattern of thrust:** Lateral to medial, superior to inferior, posterior to anterior, through the C0-C1 joint plane line, with an inferiorward arcing motion toward the end of the thrust.

**Category by algorithm:** Short lever specific contact procedure.

**Name of technique: Gonstead**

**Name of technique procedure:** PSRRSRP (+θX, -θZ, -θY) condyle adjustment (Fig. 11.25).
Indications: Extension, right lateral flexion, and left rotational fixation. Postero-superior glide (+\(\theta X\), -\(\theta Z\)), right lateral flexion (+\(X\), -\(\theta Z\)), and right axial rotation (-\(\theta Y\)) positional dyskinesia.

Contraindications: All other listings, normal FSU, hypermobility, instability, destruction of the condyle, or pathologic/nonpathologic fracture of the condyle, infection of the contact bone, and C0-C1 arthrodiesis.

Patient position: The patient is seated. The stabilization strap is placed over the crown of the left shoulder. The head is turned away from the side of contact for correction of the rotational component.

Doctor's position: Behind the patient, favoring the right side.

Contact point: The thenar pad of the right hand over the patient's right supramastoid groove.

<table>
<thead>
<tr>
<th>Gonstead Listing</th>
<th>International</th>
<th>Pattern of Thrust</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSRS</td>
<td>+(\theta X), -(\theta Z)</td>
<td>Posterior to anterior, superior to inferior, right to left, through the C0-C1 joint plane line, with an inferiorward arcing motion toward the end of the thrust.</td>
</tr>
<tr>
<td>PSRSRA</td>
<td>+(\theta X), -(\theta Z), +(\theta Y)</td>
<td>Posterior to anterior, superior to inferior, right to left, through the C0-C1 joint plane line, the head is prepositioned in right rotation.</td>
</tr>
<tr>
<td>PSRSRP</td>
<td>+(\theta X), -(\theta Z), -(\theta Y)</td>
<td>Posterior to anterior, superior to inferior, right to left, through the C0-C1 joint plane line, the head is prepositioned in left rotation.</td>
</tr>
<tr>
<td>PSL</td>
<td>+(\theta X), +(\theta Z)</td>
<td>Posterior to anterior, superior to inferior, left to right, through the C0-C1 joint plane line, with an inferiorward arcing motion toward the end of the thrust.</td>
</tr>
<tr>
<td>PSLSLA</td>
<td>+(\theta X), +(\theta Z), -(\theta Y)</td>
<td>Posterior to anterior, superior to inferior, left to right, through the C0-C1 joint plane line, the head is rotated toward the side of contact</td>
</tr>
<tr>
<td>PSLSLP</td>
<td>+(\theta X), +(\theta Z), +(\theta Y)</td>
<td>Posterior to anterior, superior to inferior, left to right, through the C0-C1 joint plane line, the head is prepositioned in right rotation.</td>
</tr>
<tr>
<td>AS</td>
<td>-(\theta X), +(\theta Z)</td>
<td>Anterior to posterior, superior to inferior, through the C0-C1 joint plane line.</td>
</tr>
<tr>
<td>ASRS</td>
<td>-(\theta X), -(\theta Z)</td>
<td>Anterior to posterior, superior to inferior, right to left, through the C0-C1 joint plane line.</td>
</tr>
<tr>
<td>ASRSRA</td>
<td>-(\theta X), -(\theta Z), +(\theta Y)</td>
<td>Anterior to posterior, superior to inferior, right to left, through the C0-C1 joint plane line, the patient's head is prepositioned in right rotation.</td>
</tr>
<tr>
<td>ASRSRP</td>
<td>-(\theta X), -(\theta Z), -(\theta Y)</td>
<td>Anterior to posterior, superior to inferior, right to left, through the C0-C1 joint plane line, the patient's head is prepositioned in left rotation.</td>
</tr>
</tbody>
</table>

Figure 11.22. A, Thenar pad contact point for PS condyle adjustments. B, Contact for the PS condyle.
Figure 11.23. A, Getting set. The doctor slides the thenar pad superiorly past the suprastoid groove to move the hair out of the way. B, Sliding down to hook the suprastoid groove for the adjustment.

Figure 11.24. PSRS condyle adjustment.

Figure 11.25. PSRSP condyle adjustment.

Figure 11.26. PSLA condyle adjustment.

Supporting hand: The left hand is used to stabilize the C1-C2 articulation on the opposite side.

Pattern of thrust: Lateral to medial, superior to inferior, posterior to anterior, through the C0-C1 joint plane line, along with an inferiorward arcing motion toward the end of the thrust.

Category by algorithm: Short lever specific contact procedure.

Name of technique: Gonstead

Name of technique procedure: PSLA (+θX, +θZ, −θY) condyle adjustment (Fig. 11.26).

Indications: Extension, left lateral flexion, left anterior rotation fixation. Postero-superior glide (+θX, −Z), left lateral flexion (+X, +θZ), and left axial rotation (−θY) positional dyskinesia.
Contraindications: All other listings, normal FSU, hypermobility, instability, destruction of the condyle, pathologic/nonpathologic fracture of the condyle, infection of the contact bone, C0-C1 arthrodesis.

Patient position: The patient is seated. The stabilization strap is placed over the right shoulder. The head is turned toward the side of contact for correction of the rotational component.

Doctor's position: Behind the patient, favoring the left side.

Contact point: Thenar pad of the left hand is placed over the patient's left supramastoid groove.

Supporting hand: The right hand will stabilize the C1-C2 articulation on the opposite side.

Pattern of thrust: Lateral to medial, superior to inferior, posterior to anterior, with an inferiorward arcing motion toward the end of the thrust, through the C0-C1 joint plane line.

Category by algorithm: Short lever specific contact procedure.

An alternate maneuver for adjusting the PS condyle can be performed in the knee-chest position (Fig. 11.27). If VBAI is present, then this position is contraindicated.

Name of technique: Gonstead

Name of technique procedure: AS ($-\delta X, +\delta Z$) condyle adjustment (Fig. 11.28).

Indications: Flexion fixation, antero-superior glide positional dyskinesia.

Contraindications: All other listings, normal FSU, hypermobility, instability, destruction of the cranium, infection of the contact bone, C0-C1 arthrodesis, fracture of the orbit.

Patient position: The patient is seated. The condyle block should be used to stabilize the lower cervical spine.

Doctor's position: Standing directly behind the patient.

Contact point: The hypothenar pad of either hand is placed over the glabella. Tissue pull is from superior to inferior.

Supporting hand: The other hand is used to stabilize, resting on top of the contact hand.

Pattern of thrust: Anterior to posterior, superior to inferior, in an inferiorward scooping motion through the C0-C1 joint plane line.

Category by algorithm: Short lever specific contact procedure.

Name of technique: Gonstead

Name of technique procedure: ASRS ($-\delta X, -\delta Z$) condyle adjustment (Fig. 11.29).

Figure 11.27. PSRS condyle adjustment on the knee-chest table.

Figure 11.28. Lateral view of the AS condyle adjustment. Notice the "scooping motion" incorporated into the thrust.
Indications: Flexion and right lateral flexion fixation. Anterosuperior glide (−θX, +Z), left lateral flexion (−θZ, +X) positional dyskinesia.

Contraindications: All other listings, normal FSU, hypermobility, instability, destruction of the cranium, or pathologic/nonpathologic fracture of the frontal bone, infection of the contact bone, C0-C1 arthrodesis, fracture of the orbit.

Patient position: The patient is seated. AS adjustments require a condyle block to stabilize the cervical spine during the thrust. If a block is not available, the cervical spine can be stabilized by using the doctor’s free hand behind the patient’s neck.

Doctor’s position: Standing behind the patient, favoring the right side.

Contact point: The right hypothenar pad is placed over the glabella. Tissue pull is from superior to inferior.

Supporting hand: The left hand is used to stabilize, resting on top of the contact hand.

Pattern of thrust: Anterior to posterior, superior to inferior, lateral to medial, in an inferoanterior scooping motion through the C0-C1 joint plane line.

Category by algorithm: Short lever specific contact procedure.

REFERENCES


