Western Regional Center for Brain & Spine Surgery

Comprehensive Neurosurgical Care

Western Neurosurgery REVIEW

A newsletter for referring doctors

Fall 2002

What's New?

- We are pleased to announce the addition of a new satellite clinic located at the MountainView Medical Office Building, 3150 N. Tenaya Way, Suite 340. Please call our main office at (702) 737-1948 or (800) 334-0878 to schedule an appointment.
- The physicians and staff of WRCBSS are pleased to welcome to the practice Mr. Robert K. Speers as our new Chief Executive Officer.
- We are also pleased to welcome two Physician Assistants—Joseph A. DeLappi, PA-C and Michael B. Houtz, PA-C—and Kimberly Reuse, RN, MSN, APN, an Advanced Practice Nurse. Please see page 3 to learn more about these new members of our clinical staff, and our new CEO.
- Dr. Venger was featured on a Channel 13 health segment as he explained the case of Mr. Horst Fischer, a patient who underwent successful treatment through Deep Brain Stimulation (DBS) surgery for Parkinson's Disease and Essential Tremors. Please visit our web site at www.brainandspineonline.com to view the newscast about DBS. If you would like to schedule a consultation for patients who suffer from Parkinson's Disease, please call our office at (702) 737-1948 or (800) 334-0878.
- Also, please visit our web site to view the Channel 13 Health Story featuring Dr. John Anson as he explains how Vertebroplasty can help patients overcome back pain.
- Western Regional Center for Brain & Spine Surgery will be featuring a "Diagnosis of the Month" section in our upcoming newsletters. If you have topic suggestions for this new feature, please forward them to our main office, attention Marketing. ■

Traumatic Occipitocervical Dislocation in Children

By Jason E. Garber, M.D.

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Traumatic occipitocervical dislocation is thought to occur in 19–35% of patients who die of cervical spine injuries. Occipitocervical (also known as atlanto-occipital) dislocation was previously considered to be a rare and largely fatal injury. However, improvement in on-the-scene stabilization allows patients with this serious condition to survive initial presentation to the emergency room. With this improvement in resuscitative efforts, more and more patients with this type of craniocervical injury will be present in the emergency room. It is therefore critical for health care professionals to recognize the types of patients who may be at high risk for atlanto-occipital dislocation and take the appropriate measures needed to maximize neurologic outcome.

Mechanism of Injury

Invariably, the majority of patients who present with occipitocervical dislocation are either passengers in automobiles or pedestrians involved in high-speed motor vehicle accidents. As previously stated, atlanto-occipital dislocation is usually a fatal injury. It is thought that occipitocervical dislocation occurs in roughly 8% of all traumatic motor vehicle fatalities. In addition to the dramatically unstable craniocervical junction, occipitocervical dislocation is highly associated with head and facial injuries. The concomitant intracranial injuries can often make a neurological examination difficult. Twenty-five percent of patients with atlanto-occipital instability have additional spinal fractures. Of the patients who survive longer than forty-eight hours after their initial injury, 25% are neurologically intact, 25% have minor neurological deficits, and 50% of patients are neurologically devastated or die.

> *Invariably, the majority of patients who present with occipitocervical dislocation are either passengers in automobiles or pedestrians involved in high-speed motor vehicle accidents.*

The highest incidence of atlanto-occipital dislocation is seen in the pediatric population. Children are three times more likely to suffer from this injury than adults. The majority of these children were involved in automobile-pedestrian accidents. The craniovertebral junction in the pediatric population is thought to be less stable than that of adults. Children have smaller occipital condyles, which articulate in virtually a horizontal plane

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with the atlas. As children grow into adulthood, full development of the occipital condyles occurs in a vertical orientation with the joint plane. With age, the condyle becomes more incorporated into an articulating joint with the atlas.

> *If the plain radiographs are abnormal or if the clinician still suspects craniocervical dislocation, then the patient should undergo thin-slice axial computed tomography (CT) from the occiput to C2 with subsequent coronal and sagittal reconstructions.*

Traumatic occipitocervical dislocation is the result of the hyper-acceleration of the head, relative to the torso beyond the tensile strength of the ligaments and tendons. The structures primarily responsible for craniocervical stability are the tectorial membrane and secondarily the apical ligament. It is felt that atlanto-occipital dislocation is most caused by hyperextension-distraction forces with subsequent disruption of the tectorial membrane, or by extreme lateral flexion coupled with hyperflexion resulting in the rupture of the alar ligaments.

Types of Atlanto-occipital Dislocation

Three types of atlanto-occipital dislocation are recognized in the literature. Type I, the most common type of injury, is characterized by anterior displacement of the occiput with respect to the atlas (C1). Type II is primarily a longitudinal distraction of the occiput from the atlas. Type III is posterior displacement of the occiput with respect to the atlas.

Neurological Presentation

Children with craniocervical dislocation exhibit varying degrees of neurologic compromise. Thirty percent of children who survive the initial atlanto-occipital dislocation are apneic, or are in cardiopulmonary arrest at the scene of the accident. Other symptoms of brainstem dysfunction include bradycardia, irregular respirations, and autonomic/blood pressure instability. An associated head injury may make the determination of neurologic deficits related to the craniocervical dislocation difficult. Neurologic findings from brainstem injury include rotatory nystagmus, ocular bobbing, decerebrate posturing, and papillary abnormalities. Motor deficits, which can range from quadriparesis, crossed hemiplegia, or hemiparesis, can also occur with occipitocervical instability. Children with incomplete initial paralysis can often make varying degrees of improvement, while those with flaccid paralysis usually have an overall poor prognosis.

Aside from direct injury to the neural tissue, vascular injuries—both compressive and ischemic—can cause neurologic sequellae. Secondary injury to the vertebral arteries can occur via compression of the vessel, intimal tearing, or thrombosis. Thrombosis of the anterior spinal artery can produce ipsilateral cranial nerve twelve (hypoglossal) palsy and crossed hemiplegia. Epidural or subdural hematomas can also occur at the point of craniocervical dislocation, producing multiple neurologic findings as well.

Figure 1

Cranial nerve palsies frequently accompany atlanto-occipital dislocation. This is thought to occur because of the downward traction of the brainstem (medulla) against their fixed points of entry into the skull base. The lower six pairs of cranial nerves are most commonly affected. Children may commonly have a dysconjugate gaze or papillary abnormalities. Cranial nerve six (abducens) is the most commonly injured nerve in atlanto-occipital dislocation. The cranial nerve palsies that are present on examination with the initial craniocervical injury tend to persist after stabilization.

> *Magnetic resonance imaging (MRI) is also helpful in evaluating the pediatric patient. In the case of occipitocervical dislocation, MRI defines the ligamentous structures and provides additional information about structural integrity.*

Radiographic Diagnosis

The diagnosis of occipitocervical dislocation requires a high degree of suspicion in a trauma patient who is either the victim of a motor vehicle accident or who has multiple mandibular and facial fractures coupled with cardiopulmonary instability. Great care should be taken to evaluate the plain film radiographs (anterior/posterior, lateral, open mouth [water's] views) taken in the emergency room. In the majority

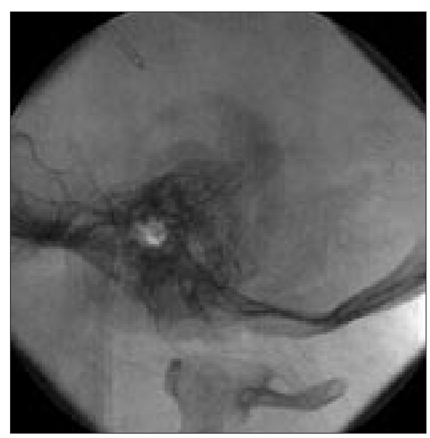

Figure 2

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Traumatic Occipitocervical Dislocation in Children, continued from page 2

of cases, gross separation between the occiput and the atlas—with or without anterior or posterior displacement—

Figure 3A

can be seen. **FIGURES 1 and 2** clearly illustrate occipitocervical dislocation. However, horizontal atlanto-occipital dislocation may not be clearly defined.

There are a number of diagnostic criteria in the literature that have been designed to measure abnormal distances between the occiput and the atlas. However, when evaluating the pediatric trauma patient, there is no clearly accepted system. This is in part because of the variances in skull and cervical ossification. Furthermore, these calculations are not necessarily reproducible in the emergency room, as the patient is required to be in a certain radiographic position. Associated factors, such as mandibular fractures, may also complicate the picture.

If the **plain radiographs** are abnormal or if the clinician still suspects craniocervical dislocation, then the patient should undergo thin-slice axial computed tomography (CT) from the occiput to C2 with subsequent coronal and sagittal reconstructions. **FIGURES 3A and 3B** are sagittal CT reconstructions, which demonstrate atlanto-occipital dislocation. Anterior/posterior CT scanning of the craniovertebral junction may also help demonstrate lateral displacement of the dens in relation to the midpoint between the two occipital condyles. It should also be noted that the lower cervical levels should be scanned if

Figure 3B

there appears to be some abnormality on plain films or if the cervical spine cannot be cleared down to C7/T1.

Magnetic resonance imaging (MRI) is also helpful in evaluating the pediatric patient. In the case of occipitocervical dislocation, MRI defines the ligamentous structures and provides additional information about structural integrity. Abnormal signal changes on the MRI may indicate ligamentous instability. The presence or absence of hematomas—subdural or epidural—can also be ruled out. **FIGURE 4** is an MRI that demonstrates the ligamentous disruption incurred with atlanto-occipital dislocation. Damage to the cervical spinal cord and brainstem, characterized by abnormal signal changes can also be determined. Rarely, atlanto-occipital instability may occur without displacement. MRI can be an excellent adjunct to CT scanning in regard to the diagnosis, and also aids in the surgical planning for patients who have sustained atlanto-occipital dislocation.

Cervical and cerebral angiography is also a useful tool to evaluate the vascular anatomy. The vertebral arteries can be assessed for integrity, particularly as they traverse the craniocervical junction. The carotid arteries can also be assessed for injury as well. This additional information may provide valuable insight into the patient's condition, as well as aid in the preoperative surgical planning.

Management of Occipitocervical Dislocation

Once the initial assessment of the child has been completed and the ABCs successfully managed, the patient is assessed neurologically. Immediate immobilization of the cervical spine is performed. The child's head is also stabilized, and careful elevation of the chest with padding or blankets reduces the flexion caused by the prominence of the occiput. The use of axial traction in children with atlanto-occipital dislocation is a highly

Figure 4

controversial topic. The concern is that neurological structures may further be injured with traction. It is therefore very

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Western Neurosurgery Review is published by Western Regional Center for Brain & Spine Surgery for the practice's referring doctors and their staffs.

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important that each child be independently evaluated prior to the use of traction. The application of a halo vest is another method of providing secure preoperative and intra-operative stabilization.

Definitive treatment of occipitocervical dislocation requires stabilization across the craniocervical junction. Rarely do ligamentous injuries heal spontaneously. Instrumentation, in conjunction with a bony fusion must therefore be performed. The fusion should span from the occiput, to C1 and to C2 (and perhaps C3), because of the ligamentous anatomy.

> *Of the patients who survive longer than forty-eight hours after their initial injury, 25% are neurologically intact, 25% have minor neurological deficits, and 50% of patients are neurologically devastated or die.*

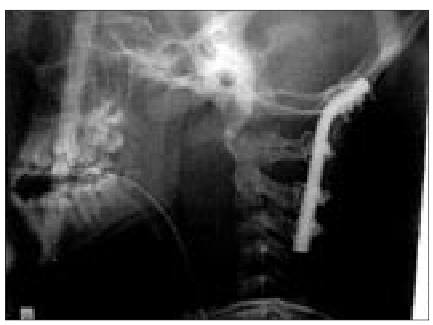


Figure 5

There are a number of techniques for performing an occipitocervical fusion. Titanium rods can be contoured in a U-shape fashion, and secured to the occiput, C1, C2, and C3 with braided cables. **FIGURE 5** is the postoperative radiograph demonstrating an occiput to C3 fusion using a contoured titanium rod and braided titanium cables. This is augmented with iliac crest bone graft. A number of pre-bent loops are on the market that can be used in conjunction with screws for fixation. Although these techniques have a high success rate of fusion, there are certain limitations. Fusion from the occiput to C2 (or C3) results in a significant reduction of flexion, extension, and rotation of the cervical spine.

Conclusion

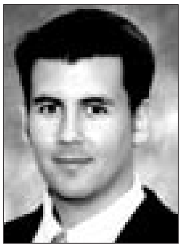
Traumatic craniocervical dislocation is usually a fatal injury. However, it is important to recognize that a pediatric trauma patient may sustain this significant cervical spine injury and survive. It is therefore crucial to provide these children with maximal medical and surgical support in order to avoid increasing neurologic sequellae. Immediate immobilization, followed by a subsequent posterior occipitocervical instrumentation/fusion, provides the pediatric patient with an excellent opportunity for stabilization and eventual improvement. □

WELCOME!

The physicians and staff of Western Regional Center for Brain & Spine Surgery are pleased to announce the addition of a new Chief Executive Officer, two Physician Assistants, and an Advanced Practice Nurse.

Robert K. Speers, the practice's new Chief Executive Officer, graduated from the University of Texas at El Paso with a Bachelor's degree in Business Administration. He went on to receive his MBA from Golden Gate University in San Francisco. Mr. Speers has a business background comprising both hospital and private practice developments. Before joining our practice, he was an administrator for Stanford University Medical Center in Palo Alto, California as well as a consultant.

Mr. Speers and his wife, Candice, are very excited to relocate to Las Vegas. They have one son, Kyle, who is currently a student at Canada College in San Mateo, California. Candice has been the Director of Nursing Education for Stanford University and is a Registered Nurse with a Master's degree in Public Health.



Joseph A. DeLappi, PA-C

Joseph A. DeLappi, PA-C, was born and raised in Scranton, Pennsylvania. After graduating from the University of Scranton with a B.S. in Biology, he attended Pennsylvania College of Technology and received a Bachelor of Science degree in Physician Assistant Studies.

Joseph acquired specialized training in Infection Control and Barrier Precautions. He also has participated in the United Health Services Brain Attack and Neuroscience Programs.

Joseph has experience in General/ Vascular/ Thoracic and Neurosurgery. He is certified as a Physician Assistant in the states of New York, Pennsylvania, and Nevada. Joseph joined our practice on July 29th and will see both clinic and hospital patients.

Michael B. Houtz, PA-C

Michael B. Houtz, PA-C, was born in Cedar Rapids, Iowa. After graduating with a B.S.B.A. from the University of Missouri-Columbia, he attended DePaul University and received his MBA in Finance.

During the years that followed the acquisition of his MBA, Michael attended Midwestern University and received a Bachelor of Medical Science in Physician Assistant studies. Michael also served as the President of the Midwestern University Physician Assistant Student Society Class of 2000.

Michael has experience in all aspects of spinal surgery and was also a clinical physician assistant in a Pain Management Clinic. Michael joined our practice on August 5th and will see clinic as well as hospital patients.

Kimberly Reuse, RN, MSN, APN

Kimberly Reuse, RN, MSN, APN was born and raised in Erie, Pennsylvania. After graduating from the University Of Edinboro with a B.S. in Nursing, she attended the University of Gannon and received a Master of Science and Nursing Degree in Critical Care Nursing.

Kimberly has experience in Neurosurgery and Trauma and is licensed in the state of Nevada as an Advanced Practice Nurse. She also holds licenses in Florida, Hawaii, and Pennsylvania.

Kimberly is the coordinator for the Brain Tumor Support Group, and has been named the March of Dimes Advanced Practice Nurse 2001–2002.

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