

EVALUATION AND MANAGEMENT OF ACUTE DUAL CERVICAL SPINAL CORD INJURIES IN SCHOOL-AGED CHILDREN

Mamadaminova Mahfuza Abduvali kizi

Qoldashev Q.A,

Ph.D., professor

Salohiddinov K.Z,

Ph.D., professor

Introduction: Cervical spinal cord injuries (SCI) in children, though rare, represent a critical area of concern in pediatric trauma, as they often result in significant, long-term disabilities. These injuries can disrupt motor, sensory, and autonomic functions, severely affecting a child's ability to engage in daily activities and achieve normal development. Among pediatric cervical spine injuries, dual cervical spinal cord injuries are particularly challenging due to the complexity and severity of their impact on the nervous system. A dual cervical spinal cord injury refers to the involvement of two or more levels of the cervical spine, leading to damage that may be both structural (such as fractures or dislocations) and functional (such as neurological deficits), requiring urgent and highly specialized care. The incidence of spinal cord injuries in children is relatively low compared to other types of injuries; however, the consequences of these injuries can be devastating. School-aged children, due to their active lifestyles, are particularly vulnerable to traumatic spinal cord injuries resulting from accidents, falls, or sports-related incidents. The underlying anatomical differences between children and adults play a crucial role in how these injuries manifest and how they are treated. Children have more flexible spines and less developed vertebrae, which makes them susceptible to different types of cervical spine injuries compared to adults. Their ligaments and spinal columns are more elastic, which can allow for greater range of motion, but also increases the risk of injury under traumatic conditions.

Acute dual cervical spinal cord injuries in children are especially concerning because the simultaneous involvement of two cervical spine levels may lead to extensive spinal cord compression, resulting in significant neurological impairment, including partial or complete paralysis, sensory deficits, and in some cases, respiratory difficulties. The clinical presentation of these injuries can vary significantly depending on the level of injury and the extent of the spinal cord involvement. Neurological damage in dual cervical injuries can lead to devastating long-term consequences, such as chronic pain, difficulty in movement, impaired cognition, and loss of autonomy. Given the delicate and developing nature of the pediatric spine, the management of these injuries requires a nuanced approach, tailored to the child's age, spinal development, and overall health. The key to successful management of acute dual cervical spinal cord injuries lies in early diagnosis and intervention. Delayed treatment or misdiagnosis can exacerbate neurological damage, resulting in permanent disability. In recent years, advancements in diagnostic imaging, such as high-resolution CT scans and MRIs, have revolutionized the way healthcare professionals identify and assess these complex injuries. These technologies have made it possible to obtain detailed images of the cervical spine, allowing for accurate identification of fractures, dislocations, ligamentous injuries, and spinal cord compression, all of which are critical for determining the appropriate course of treatment. Surgical intervention is often necessary for the

treatment of dual cervical spinal cord injuries in children, especially when there is significant spinal cord compression or structural instability of the cervical spine. The surgical options have evolved significantly, with minimally invasive techniques and innovative approaches allowing for quicker recovery times, reduced complication rates, and less trauma to the surrounding tissues. These advancements have been critical in improving the prognosis of pediatric patients, particularly when the injuries are severe and involve multiple cervical spine levels.

However, surgery alone is not sufficient. The rehabilitation process after surgery plays a vital role in the child's recovery, aiming to restore as much function as possible while addressing both the physical and emotional aspects of recovery. Physical therapy, psychological counseling, and social support are all essential components of a multidisciplinary approach that ensures a child's overall well-being and quality of life. This thesis focuses on the evaluation and management of acute dual cervical spinal cord injuries in school-aged children, analyzing current diagnostic methods, surgical approaches, and rehabilitation strategies. It also seeks to provide an in-depth review of the latest research on pediatric spinal trauma and highlight the challenges and innovations that shape the management of these injuries. By examining the complexities of these injuries and their treatment, this study aims to offer a comprehensive understanding of how to improve outcomes for children affected by acute dual cervical spinal cord injuries. The ultimate goal is to contribute to the ongoing development of more effective, targeted, and holistic care strategies that can address the multifaceted needs of these young patients.

Research Methodology.

The methodology for this thesis is a combination of qualitative and quantitative approaches to gather, analyze, and synthesize data on the evaluation and management of acute dual cervical spinal cord injuries in school-aged children. The primary research methodology is through an extensive review of existing literature on the subject. A systematic search was conducted across multiple databases, including PubMed, Google Scholar, and ScienceDirect, using keywords such as "acute cervical spinal cord injury in children," "dual cervical spine injuries," "management of pediatric SCI," "neurosurgical management of cervical injuries," and "outcomes of pediatric cervical trauma." Peer-reviewed journals, case reports, clinical trials, and meta-analyses were prioritized to ensure the most current and relevant findings were included.

Analysis and Results.

The evaluation and management of acute dual cervical spinal cord injuries in school-aged children are intricate processes requiring a multidisciplinary approach. Based on the extensive review of clinical cases, diagnostic methods, surgical interventions, and patient outcomes, a comprehensive understanding of the complexities involved in these types of injuries has emerged. Analyzing the patterns of injury, treatment modalities, and recovery timelines offers valuable insights into improving outcomes for affected children. The mechanism of injury plays a crucial role in the presentation and treatment of acute dual cervical spinal cord injuries. Unlike adult cervical spine injuries, which are predominantly the result of high-energy trauma such as motor vehicle accidents, in children, these injuries often occur due to lower-energy trauma, such as falls, sports accidents, or non-accidental trauma. The pediatric cervical spine is highly dynamic, with a greater range of motion and more elastic ligaments compared to adults. As a result, injuries in children can manifest differently. Fractures in children's cervical spines may involve damage not only to the bones but also to the ligaments and

intervertebral discs, which are less ossified and more susceptible to stretching and rupture. This creates a unique challenge in diagnosing and treating injuries that affect multiple levels of the cervical spine simultaneously. In the case of acute dual cervical spinal cord injuries, the spinal cord may be compressed at more than one level, potentially resulting in a more severe neurological deficit. These injuries often occur in the upper cervical spine, specifically in the C1-C2 region, or in the lower cervical spine, encompassing C3-C7. In some cases, both areas may be involved, complicating the assessment and management process. The pediatric cervical spine is particularly vulnerable to traumatic forces due to its anatomical characteristics. The vertebral bodies of children are smaller and more flexible, and the spinal cord itself is more sensitive to compression, making the effects of an injury potentially more severe. As a result, even seemingly minor trauma can lead to serious consequences, including paralysis, sensory deficits, and autonomic dysfunction.

The initial diagnostic approach for children with suspected cervical spine injuries includes clinical assessment followed by imaging studies. Initial radiographs, or X-rays, are typically used to assess gross anatomical abnormalities, such as fractures or dislocations. However, while X-rays are useful for identifying bony injuries, they do not provide sufficient detail about soft tissue damage, spinal cord compression, or ligamentous injuries. In cases of dual cervical injuries, more advanced imaging techniques are essential to capture a full picture of the injury. CT scans are invaluable in detecting fractures and dislocations, particularly when high-energy trauma is suspected. The ability to obtain detailed 3D reconstructions of the cervical spine allows for a comprehensive understanding of the injury's extent, and can assist surgeons in planning the necessary surgical interventions. In particular, CT imaging can provide important insights into complex fractures that may affect multiple levels of the cervical spine simultaneously. However, when spinal cord injury is suspected, MRI is often considered the gold standard for evaluating soft tissue damage, especially the spinal cord itself. MRI allows for the visualization of spinal cord compression, edema, hemorrhage, and other pathological changes that are common in acute SCI cases. In pediatric cases, MRI also plays a key role in assessing injury to the spinal cord, nerve roots, and the intervertebral discs. Moreover, it provides essential information on the degree of spinal cord involvement, which is critical for determining the prognosis and planning the treatment strategy. In cases of dual cervical injuries, the need for accurate and comprehensive imaging is even more critical, as both bony and soft tissue involvement must be addressed.

The management of acute dual cervical spinal cord injuries in children depends on the severity of the injury and the specific anatomical areas affected. For most cases, particularly those involving significant spinal cord compression, surgery is required. Surgical intervention aims to stabilize the cervical spine, decompress the spinal cord, and correct any structural deformities. The timing of surgery is a critical factor in improving outcomes, as early decompression of the spinal cord can significantly reduce the risk of permanent neurological deficits. In pediatric patients, early surgical intervention has been shown to enhance recovery and reduce complications, particularly in cases where spinal cord compression has led to neurological impairment. The goal of surgery is to restore spinal stability while minimizing trauma to the surrounding structures. Given the delicate nature of the pediatric spine, the surgical approach chosen must balance the need for effective stabilization with the preservation of the growth potential of the spinal structures. For dual cervical injuries, both anterior and posterior approaches may be necessary. The choice of surgical approach is often dictated by the level and type of injury. Anterior cervical discectomy and fusion (ACDF) is commonly used when the injury involves compression of the spinal cord from the front, such as in cases of disc herniation or

vertebral body fractures. This approach involves removing the damaged disc and replacing it with a bone graft or synthetic material to restore the stability of the cervical spine. In contrast, posterior approaches, such as posterior cervical fusion, are typically used when the injury involves the posterior elements of the spine, such as the lamina, spinous processes, or posterior ligamentous complex. In more complex cases, an occipitocervical fusion may be required to stabilize both the upper cervical spine and the occiput, particularly when the C1-C2 region is involved.

Conclusion

The management of acute dual cervical spinal cord injuries in school-aged children remains a highly complex and evolving field. These injuries, while rare, can have severe consequences if not diagnosed and treated promptly and appropriately. The pediatric cervical spine is unique in its anatomy, with a greater degree of flexibility compared to adults, which can both predispose children to specific injury patterns and contribute to unique treatment challenges. Dual cervical spinal injuries, involving multiple levels of the cervical spine, require early and precise intervention to minimize neurological damage and optimize recovery outcomes. The importance of early diagnosis cannot be overstated. Advances in imaging technologies, particularly MRI and CT scans, have significantly improved the ability to detect these injuries, enabling surgeons to visualize both the bony and soft tissue components of the injury. This precision in diagnosis directly informs treatment strategies, which, in turn, are critical in determining the child's long-term prognosis. Given the potential for severe neurological deficits, surgical intervention is often required, and the choice of approach—whether anterior, posterior, or a combination of both—depends on the specific injury patterns and the patient's unique anatomical features.

List of References:

1. Anderson, P. A., & Berven, S. H. (2013). Pediatric Spinal Cord Injuries: Management and Outcome. *Spine*, 38(10), 801-809. <https://doi.org/10.1097/BRS.0b013e31828b67fc>
2. Langer, P., & Parsch, K. (2009). Surgical treatment of cervical spine injuries in children. *European Spine Journal*, 18(2), 223-231. <https://doi.org/10.1007/s00586-008-0886-7>
3. Garton, H. J., & McKeown, J. D. (2011). Pediatric cervical spine injuries: the role of early surgical intervention. *Journal of Neurosurgery: Pediatrics*, 8(1), 11-18. <https://doi.org/10.3171/2010.10.PEDS1043>
4. Mahajan, R. L., & Srivastava, A. (2015). Pediatric cervical spine trauma: Mechanisms of injury and management. *Journal of Pediatric Orthopaedics*, 35(7), 698-706. <https://doi.org/10.1097/BPO.0000000000000326>
5. Ahn, H. S., & Kim, D. H. (2014). Surgical management of pediatric cervical spine injuries. *Orthopedic Clinics of North America*, 45(1), 43-54. <https://doi.org/10.1016/j.ocl.2013.09.004>