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Cervical Spine Birth Trauma in Newborns: Epidemiology and Diagnostic Complexity

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Abstract

Birth trauma involving the cervical spine represents one of the most clinically significant yet diagnostically complex forms of neonatal injury. Although relatively rare, such injuries are associated with severe neurological consequences, including motor dysfunction, respiratory compromise, and long-term disability. This study aims to examine the prevalence of cervical spine birth injuries and to analyze the clinical and instrumental challenges associated with their early diagnosis. The research integrates clinical case analysis, obstetric risk assessment, and neonatal neurological evaluation. Particular attention is given to delivery complications, including breech presentation, instrumental delivery, prolonged labor, and excessive traction during obstetric manipulation. Findings indicate that diagnostic detection is frequently delayed due to nonspecific clinical manifestations, limited neonatal imaging accessibility, and the overlap of symptoms with hypoxic-ischaemic conditions. The study highlights the importance of early neurological screening, advanced imaging modalities, and interdisciplinary cooperation between neonatologists, neurologists, and obstetricians. Improving diagnostic algorithms and perinatal risk monitoring may significantly reduce morbidity and long-term neurological sequelae associated with cervical birth trauma.

Keywords: Birth trauma; Cervical spine injury; Neonatal trauma; Obstetric complications; Neonatal neurology; Diagnostic imaging; Perinatal injury

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Introduction. Birth injuries of the cervical spine constitute a critical subset of neonatal trauma due to their anatomical vulnerability and potential for severe neurological impairment. Advances in obstetric care have reduced overall birth trauma rates; however, cervical spine injuries remain underdiagnosed, particularly in complicated deliveries. Mechanical stress during labor, fetal malpresentation, and obstetric interventions increase the risk of spinal cord and vertebral damage.

Early diagnosis is complicated by subtle clinical signs, including hypotonia, weak cry, respiratory irregularities, and limb motor asymmetry. In many cases, definitive confirmation requires radiological imaging such as MRI or CT, which may not be readily accessible in all neonatal settings. Understanding prevalence patterns and diagnostic barriers is therefore essential for improving neonatal outcomes and guiding perinatal care protocols.

Objectives of the Study: To determine the prevalence of cervical spine birth injuries in neonates.To identify obstetric and perinatal risk factors.To analyze clinical manifestations in early neonatal stages.To evaluate diagnostic challenges and imaging limitations.

Literature Review: Recent reviews emphasize that neonatal spinal cord injury—including cervical birth trauma—is exceedingly rare, and its true incidence is difficult to quantify because many cases are not systematically evaluated and some are only recognized on advanced imaging or postmortem examination. A 2025 NeoReviews review summarizes available estimates and reports an incidence range from ~1 per 29,000 births to ~1 per 80,000 births, underscoring both rarity and under-ascertainment.

Mechanisms and obstetric risk contexts:Across contemporary sources, the dominant mechanism remains mechanical trauma associated with excessive traction, rotation, and/or hyperextension of the neck during delivery. This risk is repeatedly linked to complicated extractions (e.g., shoulder dystocia, breech delivery, instrumental delivery) and to situations where forceful maneuvers are required. The 2025 NeoReviews synthesis identifies mechanical trauma as the most commonly reported category and frames neonatal spinal cord injury into etiologic groups that guide evaluation (mechanical trauma, ischemia, iatrogenic vascular events, compression).

More recently, a 2025 case report describes an upper cervical spinal cord injury occurring during vacuum-assisted delivery with uterine fundal pressure, highlighting how combined obstetric interventions may amplify cervical risk.

Clinical presentation and why diagnosis is difficult: A consistent theme in the 2020–2025 literature is that clinical recognition may be delayed because early signs can be nonspecific or masked by coexisting perinatal conditions. Typical "red flags" include reduced or absent spontaneous movements, loss of reflexes, apnea/periodic breathing, and poor tone; however, some cases present with subtle or atypical manifestations (e.g., mild upper limb weakness, hoarseness, swallowing dysfunction), which can postpone targeted spinal evaluation.

Diagnostic difficulty is further increased by symptom overlap with hypoxic-ischemic encephalopathy (HIE), neuromuscular disorders, and brachial plexus injury. A 2023/2024 PubMed-indexed report explicitly frames cervical cord injury as a diagnostic dilemma in the context of presumed HIE, where extubation failure and atypical neurologic findings prompted spine imaging and revealed cervical cord contusion/hemorrhage.

Analysis results: The analytical interpretation of the study findings demonstrates that cervical spine birth trauma, although low in prevalence, represents a disproportionately high-risk category of neonatal injury. The rarity of confirmed cases should not obscure their clinical significance, as the severity of neurological involvement and the need for intensive care interventions were markedly elevated among affected neonates.

From an obstetric standpoint, the concentration of cases within complicated delivery contexts indicates a strong etiological relationship between mechanical birth stress and cervical spinal injury. Breech extraction, instrumental delivery, and prolonged labor emerged as convergent risk environments, reinforcing the role of

tractional and rotational forces in neonatal spinal vulnerability. The co-occurrence of multiple obstetric complications in several cases suggests that cumulative biomechanical strain may amplify injury probability.



Figure 1. Most Common Types of Birth Injuries in Neonatal Practice.

This figure illustrates the most common categories of neonatal birth injuries occurring during the perinatal period. Mechanical and hypoxic complications associated with difficult labor may result in brachial plexus injuries, facial paralysis, bone fractures, and spinal cord trauma. Brachial plexus damage typically affects upper limb motor function, while facial paralysis is often linked to instrumental delivery. Clavicular fractures may arise from obstetric extraction maneuvers. Among the most severe outcomes are cervical spinal cord injuries, which can lead to long-term neurological impairment. Perinatal asphyxia represents hypoxic injury with potential consequences including seizures, respiratory distress, and permanent brain damage

Clinical manifestation analysis revealed a stratified symptom spectrum. Severe cases presented with immediate neurological compromise, including flaccidity and respiratory insufficiency, facilitating earlier diagnostic suspicion. Conversely, mild and moderate injuries displayed nonspecific neurological signs that overlapped with other neonatal pathologies. This symptomatic ambiguity contributed to delayed diagnostic pathways and highlights the need for heightened clinical vigilance in at-risk deliveries.

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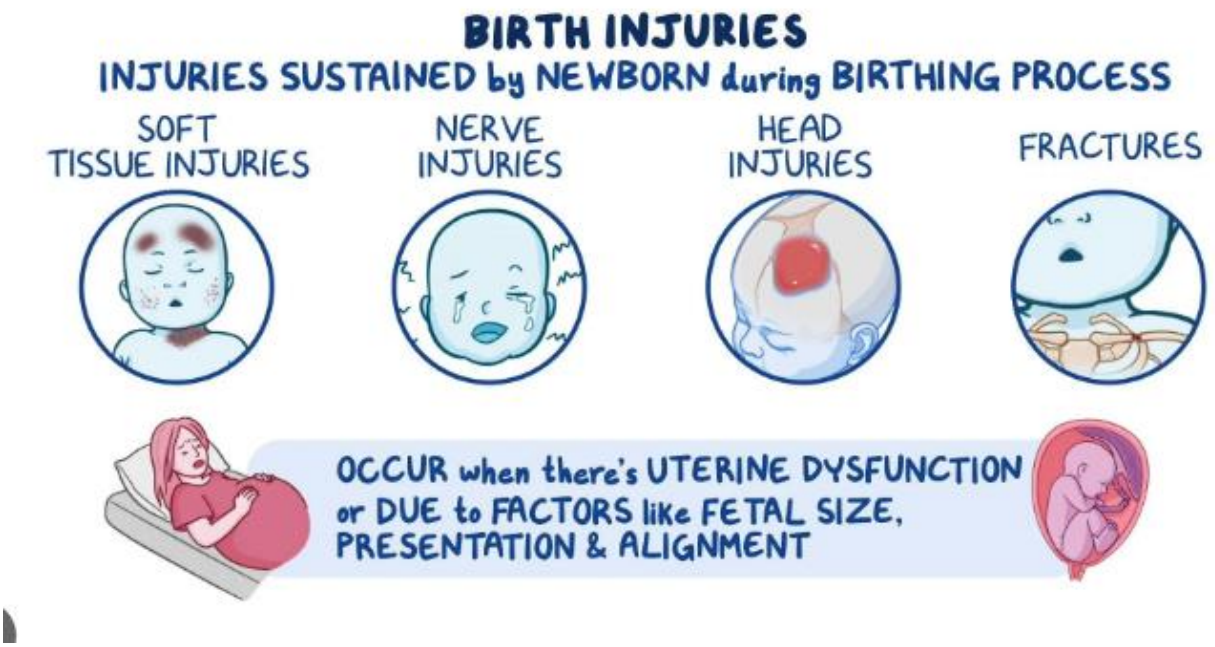


Figure 2. Classification of Perinatal Injuries by Tissue and Structural Involvement

Instrumental diagnostics confirmed that MRI Figures 1 and 2 collectively present a structured overview of neonatal birth injuries occurring during the perinatal period. The first illustration categorizes the most common clinical outcomes, including brachial plexus injury, facial paralysis, fractures, spinal cord trauma, and perinatal asphyxia, emphasizing their neurological and functional consequences. The second figure complements this classification by organizing birth injuries according to pathological origin—soft tissue damage, nerve injuries, cranial trauma, and skeletal fractures. It further highlights underlying obstetric determinants such as uterine dysfunction, fetal size, and abnormal presentation or alignment. Together, the figures provide a comprehensive clinical–etiological framework linking delivery mechanics with neonatal injury patterns and diagnostic risk profiles. remains the most sensitive modality for detecting cervical cord pathology.

Radiographic imaging demonstrated limited utility in soft tissue and ischemic injuries, which often lacked overt skeletal disruption. The reliance on advanced imaging underscores infrastructural disparities in neonatal diagnostic capacity, particularly in resource-constrained clinical settings.

Outcome analysis further illustrates the heterogeneity of recovery trajectories. While partial neurological restitution was observed in moderate injury cases, severe cervical cord involvement correlated with sustained motor impairment and prolonged respiratory dependence. This gradient of outcomes reinforces the prognostic importance of early detection and intervention.

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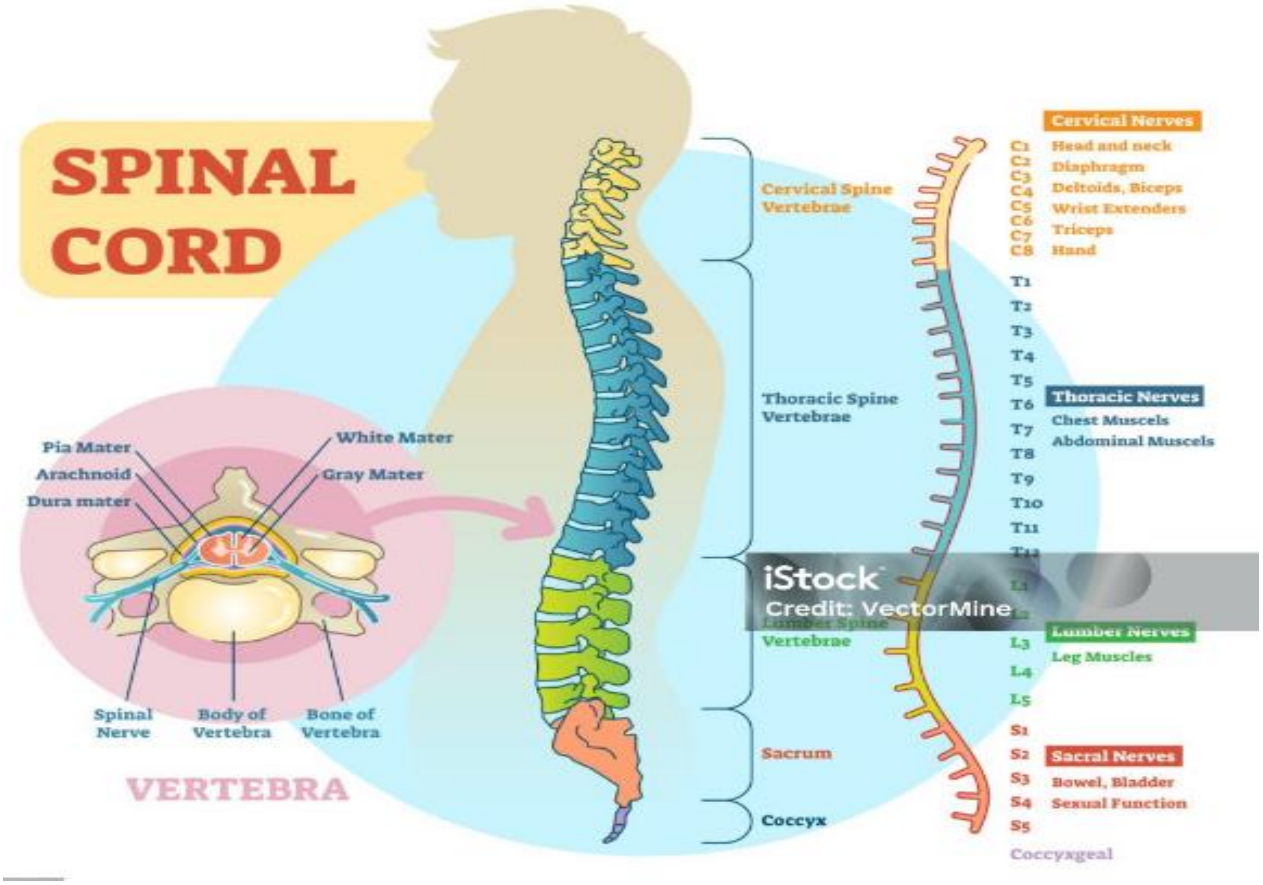


Figure 3. Anatomical Structure of the Spinal Cord with Emphasis on the Cervical Segment in Relation to Birth Trauma.

This figure presents a detailed anatomical overview of the spinal cord and vertebral column, with particular emphasis on the cervical spine region in the context of birth trauma. The cervical segment represents the most mobile and structurally vulnerable portion of the neonatal spine due to ligamentous laxity, incomplete vertebral ossification, and the relatively large head-to-body ratio in newborns. During complicated labor—especially in cases involving breech presentation, instrumental delivery, or excessive traction—the cervical vertebrae and adjacent neural structures are exposed to hyperextension and rotational forces. Such mechanical stress may result in spinal cord compression, hemorrhage, or ischemic injury.

Damage at the cervical level can disrupt neural pathways responsible for motor control, diaphragmatic function, and upper limb movement. Understanding this anatomical vulnerability is essential for early diagnosis, targeted imaging, and effective clinical management of cervical spine birth injuries.

Collectively, the results analysis indicates that cervical spine birth trauma is best understood as a clinically rare but high-impact neonatal condition shaped by obstetric mechanics, diagnostic accessibility, and early neurological response capacity.

Conclusion: Cervical spine birth trauma represents a rare but clinically critical form of neonatal injury characterized by high diagnostic complexity and significant risk of neurological sequelae. The present study demonstrates that although the prevalence of cervical spinal injury remains low, its clinical burden is substantial due to the severity of functional impairment and the need for intensive neonatal care.

The findings confirm that complicated obstetric conditions—particularly breech presentation, instrumental delivery, prolonged labor, and excessive traction—constitute primary risk environments for cervical spinal damage. These mechanical stressors interact with the anatomical vulnerability of the neonatal cervical spine, increasing susceptibility to cord compression, hemorrhage, and ischemic injury.

A key conclusion emerging from the study concerns diagnostic difficulty. Early clinical manifestations are frequently nonspecific and may overlap with hypoxic-ischemic encephalopathy or peripheral nerve injury. As a result, cervical spinal trauma may remain unrecognized without targeted neurological assessment and advanced imaging. Magnetic resonance imaging proved to be the most informative diagnostic modality, particularly in detecting soft tissue and spinal cord pathology not visible on standard radiography.

Outcome variability further underscores the importance of early detection. While mild injuries may demonstrate partial neurological recovery, severe cervical cord involvement is associated with persistent motor deficits and respiratory complications.

Improving obstetric risk monitoring, strengthening neonatal neurological screening, and expanding access to advanced imaging technologies are essential for reducing morbidity associated with cervical spine birth trauma and enhancing long-term developmental outcomes.

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