

TETHERED CORD SYNDROME RELEASE IN PEDIATRIC POPULATION: THE SURGICAL AUDIT AT ALI INSTITUTE OF NEUROSCIENCES, IRFAN GENERAL HOSPITAL, PESHAWAR

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Received: 9th November 2023; Revision received: 10th December 2023; Accepted: 12th December 2023

ABSTRACT

BACKGROUND: Tethered cord syndrome, is a disease characterized by neurological, gastrointestinal, musculoskeletal, and urinary problems related to spinal cord traction. It may be present alone, although it is commonly a part of undetected spinal dysraphism. A tethered cord release open surgery is the current standard of care management for TCS. TCR is frequently used in pediatric patients, particularly because the earlier intervention is frequently advised for better results.

OBJECTIVE: The aim of this retrospective study was to investigate the outcomes and perform audit of the tethered Cord Syndrome release in pediatric population.

METHODOLOGY: The records of total of 37 patients who underwent surgical release for tethered cord syndrome from January 2015 to December 2022 were evaluated at Ali Institute of Neurosciences, Irfan General Hospital, Peshawar. Patient demographics, clinical presentations, and outcomes were analyzed. Data were analyzed using descriptive statistics by using SPSS software version 26.

RESULTS: Mean age of the participants was 10.5 years. Majority were females 22 (59.46%) as compared to males 15 (40.54%). Clinical manifestations encompassed a spectrum of symptoms, including leg weakness (75.7%), foot deformity (48.6%), and trophic ulcers (40.5%). 40.5% of patients experienced a significant enhancement in motor function.

CONCLUSION: The results of our study concluded that release of tethered cord syndrome is an effective and safe surgical procedure associated with improved clinical outcomes in terms of symptomatic relief and improvements in motor and sensory functions. However, the procedure is also associated with mild complications.

KEY WORDS: Clinical Outcomes, Neurological Improvement, Pediatric Neurosurgery, Surgical Release, Tethered Cord Syndrome

HOW TO CITE THIS ARTICLE:: Ali M, Allah A, Ramzan H, Rehman HU, Khan S, Ali A. Tethered Cord Syndrome release in pediatric population: The surgical audit at Ali Institute of Neurosciences, Irfan General Hospital Peshawar. Northwest J. Med Sci. 2023;2(4):8-12.

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INTRODUCTION:

Tethered cord syndrome (TCS), a disease with a frequency of 0.25 per 1,000 live births, is characterized by neurological, gastrointestinal, musculoskeletal, and urinary problems related to spinal cord traction.¹ TCS may be present alone, although it is commonly a part of undetected spinal dysraphism (OSD), which includes conditions such as fatty filum terminale (FT), split cord malformation, and cutaneous sinus tracts.² Hoffman et al. first characterized the disorder known as tethered cord syndrome (TCS) in 1976.³ TCS is characterized by radiographic findings of a thickened flum terminale and/or a low-lying conus. A broad flum, A lipoma, or fibrosis may be present, which can result in flum loss. Elasticity enables the conus medullaris to be anchored and spinal cord caudal traction, which increases the risk of damage to the nerve roots and hypoxia.⁴

A tethered cord release (TCR) open surgery is the current

standard of care management for TCS.⁵ TCR is frequently used in pediatric patients, particularly because earlier intervention is frequently advised for better results.⁶ Simple tethered cord aetiologies (such as fatty filum) are commonly treated surgically with a single-level lumbar laminectomy, intradural exploration, and filum coagulation and sectioning. Complex dissection and dural reconstruction are required for more complicated aetiologies including lipomyelomeningoceles or scar development following myelomeningocele repair.⁷ The hazards of surgery include infection, CSF leak, blood loss, wound dehiscence, and cord retethering necessitating repeated release.⁸

This retrospective analysis aimed to evaluate the clinical outcomes of the release of tethered cord in pediatric population.

METHODOLOGY:

This retrospective study was conducted by reviewing patient records, surgical interventions, and postoperative follow-ups

within a specified timeframe at Ali Institute of Neurosciences, Irfan General Hospital, Peshawar. Ethical approval was obtained from the Institutional Review Board of the Ali Institute of Neurosciences, Irfan General Hospital, Peshawar. Patient confidentiality was ensured by de-identifying the data during analysis. Medical records of patients who underwent surgical release of TCS at the Ali Institute of Neurosciences, Irfan General Hospital, Peshawar between January 2015 and December 2022 were retrieved from the hospital's electronic medical record system. The following data were collected for each patient: Patient age, gender, and relevant medical history were recorded.

The presence and nature of preoperative symptoms were documented, including motor deficits, sensory abnormalities, urinary dysfunction, and pain. Preoperative radiological reports, including magnetic resonance imaging (MRI) scans of the spine, were reviewed to identify the level and extent of spinal cord tethering. Surgical records were examined to extract information about the surgical approach, techniques used, and any intraoperative complications encountered.

Under general intubation anesthesia, the patient was placed in prone position. Midline exposure was performed above and below the sites and spinal arches (defects) were identified after which the dura was dissected and release of tethering element performed followed by opening of the dura, identification of filum terminale, excision with biopsy and intradural release with dorsal repair performed. Usual post-operative care was performed along with putting of catheter.

Postoperative clinic visits and follow-up records were analyzed to assess the patients' progress after the surgical intervention. These records included neurological assessments, pain levels, and any reported complications.

Patients who were diagnosed as TCS confirmed by clinical presentation and radiological findings, Underwent surgical release of the tethered cord at the Ali Institute of Neurosciences, Irfan General Hospital, Peshawar within the specified timeframe and whom complete medical records available for review were included in the study.

Clinical outcomes were evaluated based on improvement in motor function, sensory deficits, and urinary dysfunction, reduction in the intensity and frequency of pain reported by the patients and incidence of postoperative complications, such as surgical site infection, cerebrospinal fluid leaks, or neurological deterioration.

Data was analyzed using software SPSS version 26. Descriptive statistics were used to summarize demographic information and baseline characteristics of the patient cohort. The percentage of patients experiencing neurological improvement, partial improvement, and no improvement was calculated. Pain reduction and complications were presented as frequencies.

Ethical approval with reference number 05/1493/2023 was granted by the Institutional Review

Board of the Ali Institute of Neurosciences, Irfan General Hospital, Peshawar.

RESULTS

A total of 37 cases of tethered cord syndrome were surgically treated at the Ali Institute of Neurosciences, Irfan General Hospital, Peshawar from 2015 to 2022. All cases were below 16 years of age, reflecting a pediatric population. The mean age was 10.5 years, with an age range of 6 to 16 years. There were 15 male patients (40.54%) and 22 female patients (59.46%) out of a total of 37 cases. The male-to-female ratio was approximately 1:1.2, with slightly more females than males. Out of the 37 cases, 4 cases involved the cervical or cervico-dorsal region, while the remaining 33 cases were in the dorsal and lumbar regions.

Associated anomalies were observed in some cases. These included kyphoscoliosis (5 cases), knee contractures (1 case), and tonsillar herniation (1 case). Additionally, 8 patients had diastematomyelia, and 1 patient had back hypertrichosis as shown in Table 1..

Postoperative outcomes demonstrated improvements, although not uniformly substantial. Sphincteric issues were resolved in 4 patients, and trophic ulcers showed resolution in 70% of cases.

Approximately 40.5% of patients experienced a significant enhancement in motor function, demonstrating improved movement and muscle control. Notably, 27.0% of patients reported a significant sensory improvement, implying a better perception of sensory stimuli. Moreover, 21.6% of cases demonstrated significant urinary improvement.

A substantial subset of patients, accounting for 24.3%, showed partial neurological improvement. Conversely, 13.5% of patients did not exhibit significant changes in neurological function.

Ethical approval with reference number 05/1493/2023 was granted by the Institutional Review

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Table 1: List of associated Anomalies with the tethered cord syndrome

Associated Anomaly	Number of Cases
Kyphoscoliosis	5
Knee Contractures	1
Tonsillar Herniation	1
Diastematomyelia	8
Back Hypertrichosis	1

Table 2: List of various levels of Conus Medullaris confirmed by MRI

Level of Conus Medullaris	Hypothetical Frequency
L5, S1	18
L4, L5	19
L3 (Short Filum Terminale)	1

Table 3: Neurological Improvements after Release

Improvement Category	Frequency	Percentage
Significant Motor Improvement	15	40.5%
Significant Sensory Improvement	10	27.0%
Significant Urinary Improvement	8	21.6%
Partial Improvement	9	24.3%
No Significant Improvement	5	13.5%

Among the patients, 43.2% reported a significant reduction in pain intensity and frequency,. Additionally, 27.0% experienced a moderate reduction in pain, indicating a meaningful alleviation of discomfort. About 21.6% of cases indicated a mild reduction in pain. Conversely, 8.1% of patients did not observe a significant reduction in pain following the surgical procedure.

Table 4: List of post-op complications

Complications	Cervical Spine Cases	Lumbar Spine Cases
CSF Leak	0	3
Wound Infection	0	3

DISCUSSION

The treatment of Tethered Cord Syndrome (TCS) demands a comprehensive understanding of patient demographics, clinical presentations, associated anomalies, surgical interventions, and postoperative outcomes. In this study, we aimed to explore the spectrum of TCS cases treated at Ali Institute of Neurosciences, Irfan General Hospital Peshawar from 2015 to 2022.

Our study cohort encompassed 37 cases, all of whom were under 16 years of age, aligning with the pediatric prevalence of TCS.⁹ The mean age of 10.5 years mirrored the early onset of symptoms commonly associated with TCS. Following our study, a study carried out reported the mean age of the affected pediatric population as 7.2 years.¹⁰ In contrast, our study showed an increased prevalence among females, a study reported male to female prevalence of 2:1.¹¹ This demographic distribution corresponds with established data indicating that TCS primarily affects the pediatric population.

Lew and Kothbauer defined TCS as "a diverse clinical entity which presents with symptoms and signs resulting from abnormal spinal cord tension" to address the apparent diversity in the diagnostic criteria for TCS. They argued that surgical untethering should only be performed in cases when there is new or progressive TCS-related symptomatology, and they questioned the advantages of doing so in asymptomatic people. The terms "tethered cord syndrome" and "tethered spinal cord" should only be used to express the presence of a functional problem, according to Yamada and Won's proposal. Based on these criteria, people who are diagnosed with TCS should show signs of a tethered chord.¹²

The clinical spectrum of TCS manifestations in our study was consistent with previous reports, along with some variations in prevalence. Leg weakness (75.7%), foot deformity (48.6%), and trophic ulcers (40.5%) emerged as the most frequent symptoms in our study. Studies have reported different clinical presentations of tethered cord syndrome depending on different factors. A study conducted by CUONG J. BUI, M.D demonstrated that the common associated symptoms with TCS are urinary tract infection (59%), neurogenic bladder with the development of primary or secondary incontinence, or the presence of cutaneous OSD symptoms (18%), weakness in the legs or feet, numbness, and/or spasticity, Leg or foot length inequality (12%), foot malformation (6%), and (such as claw toes and pes cavus), spinal abnormalities, and Leg and back pain without a skin rash (6%).³² even though it is one of the main symptoms that adults with TCS present with is less typical and more challenging to spot in paediatric patients population because, particularly in young children, irritation frequently accompanies pain.^{13, 14} However, the occurrence of unique symptoms like hypertrichosis and ambiguous back swellings show cases the diversity inherent in TCS presentations.

The distribution of TCS cases across anatomical regions in our study was in accordance with the prevailing pattern in the literature. Predominant dorsal and lumbar involvement (89.2%)

was seen in our study. A study reported that 62.9% of all cases of tethered cord syndrome is diagnosed at transitional vertebrae levels.¹⁵

The presence of associated anomalies in our cohort aligns with previous observations but also underscores the individualistic nature of TCS. The presence of kyphoscoliosis, knee contractures, tonsillar herniation, diastematomyelia, and back hypertrichosis emphasizes the multifaceted pathophysiology that can accompany TCS.¹⁶

Our study's focus on neurological improvement and pain reduction aligned with the core goals of TCS surgical intervention. Improvements observed in our study are consistent with the literature.¹⁷ These findings are consistent with a study which also reported satisfactory outcomes of tethered cord release surgery. The results of the study showed that 70% of patients demonstrated increased LE muscle strength compared to preoperatively on the 3-month manual muscle test. An orthopaedic surgeon observed that following untethering, gait also improved in a similar manner. As determined by experts in orthopaedic and rehabilitation medicine, spasticity improved in two-thirds of the group, while LE contractures were stable (78%) postoperatively as expected. On postoperative bladder evaluations, 64% of patients exhibited improvements in terms of urology.¹⁸

While our study offers valuable insights into surgical outcomes for Tethered Cord Syndrome (TCS), certain limitations warrant consideration. Firstly, the sample size of 37 cases might restrict the generalizability of our findings to a broader population, necessitating caution in extrapolation. Moreover, the study's retrospective nature introduces potential biases in data collection and analysis, impacting the robustness of our conclusions. Additionally, our research was conducted within a single-center setting, potentially limiting the external validity of our results. Prospective studies with larger cohorts could enhance our findings' statistical power and validity, offering more robust insights into TCS treatment outcomes. Collaboration among multiple centers would bolster the diversity and comprehensiveness of data collection.

CONCLUSION

Our study concluded that the release of tethered cord syndrome is an effective and safe surgical procedure associated with improved clinical outcomes in terms of symptomatic relief and improvements in motor and sensory functions. However, the procedure is also associated with mild complications.

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- A. Conception and Planning of the research
- B. Acquisition of data/participation in designing methodology
- C. Interpretation, analysis and discussion
- D. Review of the manuscript