



## EVALUATION OF OUTCOMES FOLLOWING DETETHERING SURGERY IN PATIENTS WITH DELAYED PRESENTATION OF TETHERED CORD SYNDROME

Dr V. Ananta Kiran Kumar

MBBS, MS (General Surgery), MCh (Neurosurgery), Assistant Professor, Department of Neurosurgery, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh

Email id: [drananth21@gmail.com](mailto:drananth21@gmail.com)

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### ABSTRACT

**Background:** TCS (Tethered cord syndrome) is a functional disorder which is stretch-induced and is associated with tethering in the caudal spinal cord to the dura mater with inelastic tissue which limits its movement. Tethered cord syndrome does not only manifest in the child subjects but also progress to the adulthood.

**Aim:** The present study was aimed to evaluate the outcomes following detethering surgery in patients with delayed presentation of tethered cord syndrome.

**Methods:** The present study assessed all the subjects that had symptomatic Tethered cord syndrome and presented to the Institute within the defined study period. All the subjects were assessed preoperatively using X-rays as ultrasonography for urinary bladder, ureter, and kidney along with urodynamic studies and MRI (magnetic resonance imaging) of brain and spine. Detethering was done and the pathological lesion was excised. Postoperative and preoperative comparison was made using Necker functional score and statistical tests.

**Results:** The study subjects were aged 8-30 years with mean age of 13.6 years. Urological manifestations were most commonly seen followed by pain, sensory deficits, asymmetric weakness, trophic and orthopedic ulcers, and bowel abnormalities in 61%, 42%, 39%, 30%, 22%, and 14% study subjects respectively. Mean symptom duration was 5.50 years. Improvements for urological manifestations, pain, sensory deficits, bowel dysfunction, motor weakness, and trophic ulcers was seen in 71%, 80%, 71%, 80%, 91%, and 100% subjects respectively. Comparison results showed a significant difference with  $p=0.003$ .

**Conclusion:** The present study concludes that detethering done in early age of affected subjects is a proven technique with the good results. Detethering result in significant improvement in subjects that have delayed presentation. Hence, it is recommended to interfere surgically by detethering even if tethering is presented late with significant details.

**Keywords:** detethering, Necker functional score, tether, tethering, tethered cord syndrome (TCS)

### INTRODUCTION

TCS (Tethered cord syndrome) is a functional disorder which is stretch-induced and is associated with tethering in the caudal spinal cord to the dura mater with inelastic tissue which limits its movement. Tethered cord syndrome does not only manifest in the child subjects but also progress to the adulthood. This abnormality in the attachment is linked with the increased tension and progressive stretching on the spinal cord during the movement of vertebral column and child growth spurts that lead to various neurological and other symptoms.<sup>1</sup>

In cases with the tethered spinal cord at its caudal end with the inelastic tissue to the dura mater and the spinal cord is not able to undergo the natural regression in the child subjects, the spinal cord is usually stretched beyond its ability of physiological tolerance. This leads to various neurological symptoms of this disorder.<sup>2</sup>

On pathophysiological analysis, neuron dysfunction in the Tethered cord syndrome is usually the result of the instability in the neurons of the spinal cord to utilize the oxygen, which is the impairment in the oxidative metabolism owing to the lack in the supply of the oxygen known as the ischemic effect and dysfunction of the ion channel directly related to the stretching of the neuronal membrane. On clinical assessment, it is manifested as progressive musculoskeletal, urological, motor, and sensory deformities.<sup>3</sup>

Previous literature data suggest a definitive role of surgical detethering in subjects that are at early age during the presentation owing to the probability of the irreversibility of the various symptoms. Improvement seen after detethering in subjects that have delayed presentation of Tethered cord syndrome is still controversial with varying results and existing literature data is scarce.<sup>4</sup> Hence, the present study was aimed to evaluate the outcomes following detethering surgery in patients with delayed presentation of tethered cord syndrome.

## **MATERIALS AND METHODS**

The present prospective clinical study was aimed to evaluate the outcomes following detethering surgery in patients with delayed presentation of tethered cord syndrome. The study subjects were from Department of Neurosurgery of the Institute. Verbal and written informed consent were taken from all the subjects before study participation.

The study assessed all the subjects that had the diagnosis of tethered cord syndrome at the Institute within the defined study period. The inclusion criteria for the study were subjects that were symptomatic cases of tethered cord syndrome presenting at or after secondary growth spurt in age of 8-10 years. The exclusion criteria for the study were subjects that had symptomatic presentation of tethered cord syndrome that presented before secondary growth spurt of age <8 years.

In 72 study subjects, preoperative assessment was done based on the urodynamic studies, magnetic resonance imaging (MRI) brain and spine, ultrasound kidney, ureter, urinary bladder (KUB), plain X-ray, and clinical features. Subjects were graded considering their deficits following the NFS (Necker functional scoring) as described in Table 1.

Urological and orthopedic assessment was done by the concerned departments. All the subjects were then undergoing the detethering of the cord in the conventional and standardized manner after excision of the thickened filum terminale and the associated factors that led to tethering as adhesive bands and lipomeningocele. In selected subjects, intraoperative neuromonitoring was done.

All the subjects were followed up at assessment by utilizing the ultrasound of the KUB region, MRI of the whole spine, and the clinical assessment at recall intervals of 3, 6, and 12 months and then after a year every year.

## **RESULTS**

The present prospective clinical study was aimed to evaluate the outcomes following detethering surgery in patients with delayed presentation of tethered cord syndrome. The present study assessed 72 subjects that had symptomatic Tethered cord syndrome and presented to the Institute within the defined study period. Among 72 subjects assessed, there were 28 females and 44 male subjects. Mean age of the study subjects was 13.6 years with the age range of 8-30 years. There were 64% (n=46) and 36% (n=26) were secondary cases that underwent previous spinal surgery or tethering from the secondary causes. The presentations seen are described in Table 2.

The most common presentation seen in the study subjects was urological manifestations seen in 61% (n=44) study subjects. Mean duration of the symptoms seen in seen subjects was 5.54 years. Various skin manifestations were linked with primary cases in 56.5% (n=26) study subjects (Table 3). Most common radiological finding seen in the study subjects was thickened filum terminale seen in 77.7% (n=56) cases followed by low lying conus which was below L2 in 41.6% (n=20) study subjects (Table 3).

It was seen that following detethering, there was a significant improvement in all the manifestations in the study subjects. Improvement in pain, sensory dysfunction, and bowel dysfunction was seen in 85%, 70%, and 80% study subjects respectively. All the subjects that had trophic ulcer and motor weakness showed a significant improvement. Least improvement was seen in the orthopedic manifestations and postsurgical manifestations were seen in 8 study subjects.

The study results showed satisfactory overall functional outcome with detethering. On preoperative assessment, score above 15 in NFS system were seen in 25% study subjects, whereas, on postoperative assessment showed, 86% subjects had score above 15 in NFS system. Comparison for the postoperative and preoperative NFS was statistically assessed which was statistically significant with p=0.002.

## **DISCUSSION**

The present study assessed 72 subjects that had symptomatic Tethered cord syndrome and presented to the Institute within the defined study period. Among 72 subjects assessed, there were 28 females and 44 male subjects. Mean age of the study

subjects was 13.6 years with the age range of 8-30 years. There were 64% (n=46) and 36% (n=26) were secondary cases that underwent previous spinal surgery or tethering from the secondary causes. The presentations seen are described in Table 2. These data were comparable to the previous studies of Garcés-Ambrossi GL et al<sup>5</sup> in 2009 and Elmesallamy Wet al<sup>6</sup> in 2019 where study design similar to the present study was also reported by the authors in their studies.

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The study results showed that following detethering, there was a significant improvement in all the manifestations in the study subjects. Improvement in pain, sensory dysfunction, and bowel dysfunction was seen in 85%, 70%, and 80% study subjects respectively. All the subjects that had trophic ulcer and motor weakness showed a significant improvement. Least improvement was seen in the orthopaedic manifestations and postsurgical manifestations were seen in 8 study subjects. These findings were in agreement with the results of Klekamp J<sup>9</sup> in 2011 and Khoshhal KI et al<sup>10</sup> in 2012 where various improvements after detethering comparable to the present study were also reported by the authors.

It was also seen that there was satisfactory overall functional outcome with detethering. On preoperative assessment, score above 15 in NFS system were seen in 25% study subjects, whereas, on postoperative assessment showed, 86% subjects had score above 15 in NFS system. Comparison for the postoperative and preoperative NFS was statistically assessed which was statistically significant with p=0.002. These results were in line with the findings of Bowman RM et al<sup>11</sup> in 2009 and Garg K et al<sup>12</sup> in 2014 where results for overall functional outcomes reported by the authors were comparable to the results of the present study.

## CONCLUSION

Within its limitations, the present study concludes that detethering done in early age of affected subjects is a proven technique with the good results. Detethering result in significant improvement in subjects that have delayed presentation. Hence, it is recommended to interfere surgically by detethering even if tethering is presented late with significant details.

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S. No	Score	Bowel	Bladder	Sensory	Motor
1.	1	Incontinence	Night and day incontinence	Amputation Skin ulceration	Major deficit Wheel chair
2.	2	Digital maneuver Painful constipation	Retention Night incontinence	Pain	Two crutches Major orthosis
3.	3	Constipation	Intermittent catheterization	Painless deficit	Distal orthosis
4.	4	Normal	Stress incontinence, dysuria	Normal	Waking fatigue
5.	5		Normal		Normal

**Table 1: Necker functional scoring system used in the study**

S. No	Presentation	Number (n)	Percentage (%)	Postoperative involvement	
				n	%
1.	<b>Orthopedic deficits</b>	16	22	6	51
2.	<b>Bowel anomalies</b>	10	14	8	80
3.	<b>Trophic ulcers</b>	16	22	16	100
4.	<b>Urological deficits</b>	44	61	32	73
5.	<b>Lower limb weakness</b>	22	30	20	91
6.	<b>Sensory deficits</b>	28	39	20	71
7.	<b>Low backache</b>	30	41.6	24	80

**Table 2: Postoperative involvement and various presentations in study subjects**

S. No	Characteristics	Number (n)	Percentage (%)
1.	<b>Mean age (years)</b>	13.6	
2.	<b>Gender</b>		
a)	Female	28	39
b)	Male	44	61
3.	<b>Primary</b>	46	64
4.	<b>Secondary</b>	26	36
5.	<b>Cutaneous presentation (n=46)</b>		
a)	Subcutaneous dermoid	2	
b)	Hair tuft	8	
c)	Dimpling of skin	6	
d)	Dermal sinus	10	
6.	<b>Radiological findings</b>		
a)	Terminal lipoma	4	5
b)	Dermoid	6	8.33
c)	Dermal sinus tract	4	5.5
d)	Syrinx	4	5.5
e)	Hemivertebra	2	2.7
f)	Split cord	8	11
g)	Adhesive bands	8	11
h)	Low lying conus	30	41.6
i)	Thickened filum terminale	56	77.7

**Table 3: Demographic and disease characteristics in the study subjects**