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Analysis Of Cases Operated With Open Spinal Dysraphism Diagnosis And Undergoing Additional Operation Due To Tensioned Spinal Cord Syndrome Developing In Their Follow-Ups

Açık Spinal Disrafizm Tanısı İle Opere Edilen Ve Takiplerinde Gelişen Gergin Omurilik Sendromu Nedeni İle İlave Operasyon Geçiren Vakaların Analizi

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ABSTRACT

Objective: The study was designed to elaborate on additional surgical needs, compare the morbidity and mortality of patients diagnosed with open spinal dysraphism, and statistically analyze the results obtained, thus concretizing both our and the families' expectations and predictions.
Method: This retrospective analysis examined open spinal dysraphism patients who underwent additional surgical intervention due to tethered cord syndrome that developed during their follow-up, as well as all the cases that were operated on due to closed spinal dysraphism during the same years. In total, 96 cases diagnosed with open spinal dysraphism and 42 cases diagnosed with closed spinal dysraphism were included in the study.
Results: Paraparesis was detected at 21.9% in the open group and 2.4% in the closed group. Paraplegia was found at 45.8% in the open group but not in the closed group. Monoparesis was seen at 4.2% in the open group and 19.0% in the closed group. In addition, when the open spinal dysraphism cases were examined within themselves, those who underwent additional TCS surgery had a higher rate of normal neurological examination (29.1%). In comparison, paraplegia was detected at a higher rate in those who did not undergo additional TCS surgery (68.3%). In addition, it was observed that hydrocephalus, shunt requirement, Chiari Malformation, scoliosis/kyphosis presence, urological problems, gastrointestinal problems, and mortality rates were higher in open spinal dysraphism cases ($p<0.001$).
Conclusion: These findings highlight the need for careful follow-up evaluation of patients with open spinal dysraphism and establishing precise long-term follow-up strategies post-surgery.

Keywords: Spinal Dysraphism, Tethered Cord Syndrome, Neural Tube Defect, Pediatric Neurosurgery.

ÖZET

Amaç: Çalışma, ek cerrahi ihtiyaçları ayrıntılı olarak ele almak, açık spinal disrafizm tanısı almış hastaların morbidite ve mortalitesini karşılaştırmak ve elde edilen sonuçları istatistiksel olarak analiz etmek, böylece hem bizim hem de ailelerin beklentilerini ve öngörülerini somutlaştırmak için tasarlanmıştır.
Yöntem: Bu retrospektif analizde, takipleri sırasında gelişen gergin omurilik sendromu nedeniyle ek cerrahi müdahale geçiren açık spinal disrafizm hastaları ve aynı yıllarda kapalı spinal disrafizm nedeniyle ameliyat edilen tüm olgular incelenmiştir. Çalışmaya toplam 96 açık spinal disrafizm tanısı almış ve 42 kapalı spinal disrafizm tanısı almış olgu dahil edilmiştir.
Bulgular: Açık grupta %21.9, kapalı grupta %2.4 oranında paraparezi saptanmıştır. Açık grupta %45.8 oranında parapleji saptanmış ancak kapalı grupta saptanmamıştır. Monoparezi açık grupta %4.2, kapalı grupta ise %19 oranında görülmüştür. Ayrıca açık spinal disrafizm olguları kendi içlerinde incelendiğinde ek TCS cerrahisi geçirenlerde normal nörolojik muayene oranı daha yüksekti (%29.1). Buna karşılık ek TCS cerrahisi geçirmeyenlerde parapleji daha yüksek oranda tespit edildi (%68.3). Ayrıca açık spinal disrafizm olgularında hidrosefali, şant gereksinimi, Chiari Malformasyonu, skolyoz/kifoz varlığı, ürolojik sorunlar, gastrointestinal sorunlar ve mortalite oranlarının daha yüksek olduğu görüldü ($p <0.001$).
Sonuç: Bu bulgular, açık spinal disrafizm tanısı konulan hastaların dikkatli izlenmesi ve cerrahi müdahale sonrası uzun dönemli takip stratejilerinin hassasiyetle belirlenmesi gerektiğini vurgulamaktadır.

Anahtar Kelimeler: Spinal Disrafizm, Tethered Kord Sendromu, Nöral Tüp Defekti, Pediatrik Nöroşirurji.

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INTRODUCTION

Neural tube defects (NTD) are among the congenital anomalies frequently seen in the neonatal period. Meningomyelocele and myelocele, which constitute the majority of open spinal dysraphism cases, are a type of neural tube defect that occurs due to the failure of the neural tube to close between the 3rd and 4th weeks of gestation [1]. Although its worldwide incidence varies depending on race, gender, geography, and socioeconomic status, it is seen in approximately 0.17-6.39/1000 live births. While the molecular mechanisms affecting neurulation are still unclear, it has been stated that maternal folic acid use reduces the risk, and folate-related genes play a role. Meningomyelocele has a wide clinical spectrum and, together with associated anomalies, significantly affects mortality and morbidity. Pathologies such as hydrocephalus, Arnold Chiari type 2 malformation, orthopedic diseases, and urinary developmental defects are frequently observed. Therefore, treatment and follow-up require a multidisciplinary approach and psychological support [2]. Prenatal screening and examinations can detect pathology in 90% of cases and provide medical and psychological support until birth for families who do not consider termination [3].

Hydrocephalus is seen in 80% of meningomyelocele cases and is the most common complication requiring surgical treatment after sac closure. Tonsillar herniation is among the crucial factors leading to hydrocephalus at birth or after meningomyelocele repair. The volume, location, and accompanying anomalies of the meningomyelocele sac play an essential role in determining the patient's condition in terms of surgical planning and prognosis [4].

Within the scope of this research, we aimed to elucidate health issues and complications that may arise during the follow-up process of patients diagnosed with open spinal dysraphism. The study was designed to compare the morbidity and mortality of patients diagnosed with open spinal dysraphism, examine additional surgical needs in detail, and statistically analyze the results obtained, thus concretizing both our and the families' expectations and predictions.

METHOD

This retrospective analysis included 96 cases who underwent surgery with the diagnosis of open spinal dysraphism in our clinic between 2016 and 2022 and underwent additional surgical intervention due to tethered cord syndrome (TCS) during their follow-up. The cases that did not need further surgery during their follow-up and the cases that underwent surgery with the diagnosis of closed spinal dysraphism during the same period were included in the scope of our study.

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Our institution has granted ethics committee approval with protocol number 2011-KAEK-25 2023/03-07, and informed consent has been obtained from all participants.

The clinical data and operation epicrisis regarding the patients were obtained from the hospital's electronic database. At the same time, the patient's scans, examination findings, anamnesis age, gender, neurological examination, spina bifida type, presence of hydrocephalus, need for shunt, presence of Chiari Malformation, presence of scoliosis/kyphosis, diastometamyelia, presence of bone spur, need for additional TCS operation, age at additional TCS operation, urological problems, gastrointestinal problems and follow-up period were analyzed.

Statistical Analysis

Patient data collected within the scope of the study were analyzed with the IBM Statistical Package for the Social Sciences (SPSS) for Windows 26.0 (IBM Corp., Armonk, NY) package program. Frequency and percentage for categorical data and mean and standard deviation for continuous data were given as descriptive values. For comparisons between groups, the “Independent Sample T-test” was used for two groups, and the “Pearson Chi-Square Test” was used to compare categorical variables.

In the comparison of the follow-up periods of the open and closed spinal dysraphism cases evaluated in the study and the comparison of the follow-up periods between the cases with and without additional TCS operation and the closed spinal dysraphism cases, the Independent Groups t-test was used between paired groups and One-Way ANOVA Analysis was used in groups of three and above. In addition, the Games-Howell Test was used in paired group comparisons in One-Way ANOVA analysis. The Chi-square test was used to compare the rates related to gender, neurological examination, and clinical features of the open and closed spinal dysraphism cases evaluated in the study. The conformity of the data to normal distribution was checked with kurtosis and skewness values (±1.5). The results were considered statistically significant when the p-value was less than 0.05.

RESULTS

This retrospective analysis enrolled 96 cases who underwent surgery with the diagnosis of open spinal dysraphism. The mean follow-up period (years) of the open spinal dysraphism cases evaluated in the study was 4.80±2.10 (Min.=1.00-Max.=8.00), and the mean age for additional TCS surgery was 2.58±1.57 (Min.=1.00-Max.=6.00). The mean age of the closed spinal dysraphism cases evaluated in the study was 4.67±3.88 (Min.=1.00-Max.=13.00), and the mean follow-up period (years) was 3.67±1.84 (Min.=1.00-Max.=8.00) (Table 1).

Table 1. Follow-up Period and Ages of Additional TSC Surgery Operations During Follow-up of Open Spinal Dysraphism Cases Evaluated in the Study

	n	%	Mean	SD	Minimum	Maximum
Follow-up Period (Years)	96	100,0	4,80	2,10	1,00	8,00
Additional TSC Operation age	55	57,3	2,58	1,57	1,00	6,00

SD=Standard Deviation.

The mean follow-up period (years) of the open spinal dysraphism cases evaluated in the study was 4.80±2.10, and the mean follow-up period of the closed spinal dysraphism cases was 3.67±1.84. According to the Independent Groups t-test, the follow-up period means of open spinal dysraphism cases were statistically significantly higher than those of closed spinal dysraphism cases (p =0.003) (Table 2).

Table 2. Age and Follow-up Periods of Closed Spinal Dysraphism Cases

	n	Mean	SD	Minimum	Maximum
Age	42	4,67	3,88	1,00	13,00
Follow-up Period (Years)	42	3,67	1,84	1,00	8,00

SD=Standard Deviation.

Regarding gender, 55 (57.3%) of the open spinal dysraphism cases evaluated in the study were female, and 20 (47.6%) of the closed spinal dysraphism cases were female. According to the Chi-Square Test, the Female/Male ratios (1.19) between open and closed spinal dysraphism cases did not differ statistically significantly (p=0.394).

According to the Chi-Square Test, when the neurological examination findings between open and closed spinal dysraphism cases were examined, 22.9% of the open group exhibited normal findings. In comparison, 78.6% of the closed group showed normal findings (p <0.001). Paraparesis was detected at a rate of 21.9% in the open group and only 2.4% in the closed group. Paraplegia was found in 45.8% of the open group, while this situation was not encountered in the closed group. Monoparesis was found in 4.2% of the open group and 19.0% of the closed group. Monoplegia was found in 5.2% of the open group, while this situation was not encountered in the closed group. As a result, according to the Chi-Square Test, it was found that the neurological examination rates between open and closed spinal dysraphism cases differed at a statistically significant level (p <0.001).

According to the Chi-Square Test, it was found that open spinal dysraphism cases had statistically significant higher rates of hydrocephalus (p <0.001), shunt requirement (p <0.001), Chiari Malformation (p <0.001), scoliosis/kyphosis presence (p <0.001), urological problems (p <0.001), gastrointestinal issues (p =0.001), additional TCS Operation (p <0.001), mortality (p =0.022) compared to closed spinal dysraphism cases. Additionally, the rates of spinal dysraphism types (myelomeningocele and

meningocele) did not differ statistically significantly between cases with and without additional TCS operation (p =0.391) (Table 3).

Table 3. Comparison of the Rates of Open and Closed Spinal Dysraphism Cases Evaluated in the Study with Clinical Features

		Open Surgery		Closed Surgery		P-value
		n	%	n	%	
Hydrocephalus	(-)	20	20,8	42	100,0	**<0,001**
	(+)	76	79,2	0	0,0	
Need for Shunt	(-)	32	33,3	42	100,0	**<0,001**
	(+)	64	66,7	0	0,0	
Chiari Malformation	(-)	35	36,5	42	100,0	**<0,001**
	(+)	61	63,5	0	0,0	
Presence of Scoliosis / Kyphosis	(-)	32	33,3	37	88,1	**<0,001**
	(+)	64	66,7	5	11,9	
Diastometamyelia	(-)	59	61,5			-
	(+)	37	38,5			
Presence of Bone Spur	(-)	65	67,7	34	81,0	0,112
	(+)	31	32,3	8	19,0	
Urological Problems	(-)	39	40,6	37	88,1	**<0,001**
	(+)	57	59,4	5	11,9	
Gastrointestinal Problems	(-)	69	71,9	41	97,6	**0,001**
	(+)	27	28,1	1	2,4	
Additional TSC Operation	(-)	41	42,7	42	100,0	**<0,001**
	(+)	55	57,3	0	0,0	
Mortality	(-)	85	88,5	42	100,0	**0,022**
	(+)	11	11,5	0	0,0	

In the study, it was found that 9 (21.4%) of the closed spinal dysraphism cases had thick filum terminale, 11 (26.2%) had dermal sinus tract, 13 (31%) had diastometamyelia, 4 (9.5%) had intradural lipoma, 4 (9.5%) had filum terminale lipoma, and 1 (2.4%) had a neurenteric cyst.

According to the Games-Howell Test result applied to the One-Way ANOVA Analysis, it was found that the mean follow-up period of the cases that underwent additional TCS surgery was statistically significantly higher than the cases that did not undergo surgery (p =0.006). In addition, it was found that the follow-up period means of the cases that underwent additional TCS surgery were statistically significantly higher than the cases that underwent surgery due to closed spinal dysraphism (p <0.001) (Table 4).

Table 4. Comparison of Follow-up Periods between Cases Evaluated in the Study that Underwent Operation with Open Spinal Dysraphism Diagnosis and Underwent Additional GOS Operation in Follow-up and that Underwent Operation with Closed Spinal Dysraphism Diagnosis

	Additional TSC Operation (+) (I)		Additional TSC Operation (-) (II)		Closed Spinal Dysraphism (III)		P-value		
	Mean	SD	Mean	SD	Mean	SD	I-II	I-III	II-III
Follow-up Period	5,88	1,75	4,02	2,3	3,67	1,84	**0,006**	**<0,001**	0,716

SD=Standard Deviation, One-Way ANOVA Analysis, Games-Howell Test result.

The Chi-Square Test found that the K/E ratios did not differ statistically significantly between the cases with and without additional TCS surgery and closed spinal dysraphism. Thus, it was found that the rates of neurological examination findings were statistically significantly different between cases with and without additional TCS surgery (p =0.002), between cases with and without additional TCS surgery and closed spinal dysraphism (p <0.001), and between cases without and without additional TCS surgery and closed spinal dysraphism (p <0.001). Accordingly, the rate of normal neurological findings (29.1%) was higher in cases with additional TCS surgery compared to cases without additional TCS surgery (14.6%), and this rate was the highest in cases with closed spinal dysraphism (78.6%) compared to both other groups. Paraplegia was detected at a higher rate in those without additional TCS surgery (68.3%).

It was found that cases without additional TCS operation had significantly higher shunt requirement (p =0.041) and mortality (p <0.001) rates compared to operated patients. Cases with additional TCS

operation had significantly higher rates of hydrocephalus (p <0.001), shunt requirement (p <0.001), Chiari Malformation (p <0.001), scoliosis/kyphosis (p <0.001), urological problems (p <0.001), gastrointestinal issues (p =0.002) compared to closed spinal dysraphism cases.

Table 5. Comparison of the Rates Related to Clinical Features between Open Spinal Dysraphism Diagnosis and Operated Cases with Additional GOS Operations and Those Who Did Not and Closed Spinal Dysraphism Cases Evaluated in the Study

		Additional TSC Operation (+) (I)		Additional TSC Operation (-) (II)		Closed Spinal Dysraphism (III)		P-value		
		n	%	n	%	n	%	I-II	I-III	II-III
Hydrocephalus	(-)	14	25,5	6	14,6	42	100			
	(+)	41	74,5	35	85,4	0	0	0,197	**<0,001**	**<0,001**
Need for Shunt	(-)	23	41,8	9	22	42	100	**0,041**		
	(+)	32	58,2	32	78	0	0		**<0,001**	**<0,001**
Chiari	(-)	22	40	13	31,7	42	100	0,404		
Malformation	(+)	33	60	28	68,3	0	0		**<0,001**	**<0,001**
Scoliosis / Kyphosis	(-)	21	38,2	11	26,8	37	88,1	0,243		
	(+)	34	61,8	30	73,2	5	11,9		**<0,001**	**<0,001**
	(-)	30	54,5	29	70,7	-	-	0,107		
Diastometamyelia	(+)	25	45,5	12	29,3	-	-		-	-
Bone Spur	(-)	35	63,6	30	73,2	34	81	0,323		
	(+)	20	36,4	11	26,8	8	19		0,062	0,399
Urological	(-)	25	45,5	14	34,1	37	88,1	0,264		
Problems	(+)	30	54,5	27	65,9	5	11,9		**<0,001**	**<0,001**
Gastrointestinal	(-)	41	74,5	28	68,3	41	97,6	0,5		
Problems	(+)	14	25,5	13	31,7	1	2,4		**0,002**	**<0,001**
	(-)	55	100	30	73,2	42	100	**<0,001**		
Mortality	(+)	0	0	11	26,8	0	0		-	**<0,001**

Hydrocephalus, shunt requirement, Chiari Malformation, scoliosis/kyphosis, urological problems, gastrointestinal problems, and mortality rates were statistically significantly higher in cases without additional TCS operation than closed spinal dysraphism cases (p <0.001) (Table 5).

DISCUSSION

Spinal dysraphism is a complex, congenital disorder that occurs due to abnormal development of the spinal cord, meninges, and vertebral structures as a result of neural tube defects in the early stages of pregnancy.. This condition is one of the most complex congenital defects compatible with life, and 50% of patients lose their lives in the intrauterine period or during birth [5]. For the remaining 50% and their families, this condition is an essential physical, sociological, and psychological process, requiring serious effort and a multidisciplinary approach. A study in our country determined that the frequency of NTD was 3 in 1000 births, and 35% of these cases were meningomyeloceles [6]. This rate is approximately similar to the worldwide incidence. In the literature, it was determined that meningomyelocele is more common in female. This rate was consistent with the literature [7]. In our study, 55 (57.3%) of the open spinal dysraphism cases were female, while 20 (47.6%) of the closed spinal dysraphism cases were female.

McCarthy et al. [8] conducted a study on 10.627 patients with meningomyelocele and reported that 57% of the patients required a repeat operation following the pouch repair after primary repair. In our research, in line with this study, the follow-up period (years) of the open spinal dysraphism cases was determined to be 4.80±2.10 on the mean, and the mean age for additional TCS surgery was determined to be 2.58±1.57. We found that 57.3% (n=55) of the patients required further surgery.

Our study determined the mean age of closed spinal dysraphism cases was 4.67±3.88, and the mean follow-up period (years) was 3.67±1.84. At the same time, the mean follow-up period (years) of open spinal dysraphism cases was determined to be 4.80±2.10. The comparison between the follow-up periods of closed and open spinal dysraphism cases determined that the follow-up periods of open spinal dysraphism cases were statistically significantly more extended (p =0.003). These results can be

considered an important indicator that open spinal dysraphism cases may need a more extended follow-up period during the treatment process.

Sert O. et al. [9] investigated the neurological conditions of the patients and indicated that 64.6% (n=53) had paraplegia, 25.6% (n=21) had paresis, and 9.8% (n=8) did not have muscle strength loss. In a study by Hiçdönmez et al. [10], 69 cases were examined. In the neurological examinations of the patients, 42% were normal, and 58% were abnormal. Bülbül et al. [11] detected hypotonia in 90% and areflexia in 10% of the cases, while normal neurological status was observed in 5%.

Studies in the current literature show that muscle strength loss is an essential finding in patients. In a study by Özgür et al. [12], muscle strength loss was detected in 90% of the cases. These findings show that muscle strength loss, seen as a typical symptom of open spinal dysraphism, is frequently observed and that different studies in the literature support similar trends on this subject. In our research, if we look at the rates of open spinal dysraphism neurological examination findings, it was found that normal was 22.9% (n=22), paraparesis was 21.9% (n=21), paraplegia was 45.8% (n=44), monoparesis was 4.2% (n=4) and monoplegia was 5.2% (n=5), consistent with the literature.

No sudden complaints or deficits occurred over time when the patient's symptoms were examined. Edström et al. [13] observed the % of patients with motor symptoms was 19%, and 76% were asymptomatic. When other studies in the literature were examined, motor losses were encountered at a rate of 23.5-93% in TCS [14, 15]. Our study on the neurological examination results in patients with closed spinal dysraphism found a normal neurological examination rate of 78.6% (n=33). In this group, paraparesis was found at a rate of 2.4% (n=1), and monoparesis was found at 19% (n=8). Different rates were found in similar studies in the literature. When the rates of neurological examination findings were compared between open and closed spinal dysraphism cases in our study, we found a statistically significant difference between the two groups ($p < 0.001$). We believe that this is because open and closed spinal dysraphism causes significant differences in neurological examination as a result of the difference in the severity and extent of damage to the spinal cord.

Patients with open or closed spinal dysraphism and a final diagnosis of TCS are usually characterized by a variety of symptoms, including motor deficits, urological symptoms, progressive spinal deformities (scoliosis), foot deformities (hallus valgus, pes equinus, pes equinovarus and valgus), skin manifestations and trophic ulcers. However, TCS is more commonly observed in adulthood with perianal (perianal, perineal) pain, urological symptoms, and motor deficits. Studies have shown that motor deficits range from 23.5% to 93.0%, skin findings range from 46.0% to 98.0%, sphincter defects range from 19.0% to 62.8%, problems in the anus region range from 7.7% to 79.4%, foot deformities range from 32.3% to 63.0%, and scoliosis range from 16.0% to 29.0%. These findings emphasize that TCS manifests itself in different age groups and with various symptoms and that multiple factors should be considered in the diagnostic process [16]. The association of hydrocephalus and TCS can be observed in the literature at rates ranging from 60% to 95%. Studies have shown that Chiari Malformation frequently accompanies TCS [17]. In our research, we found that 79.2% (n=76) of the patients had hydrocephalus, 63.5% (n=61) had Chiari Malformation, 50% (n=69) had scoliosis/kyphosis deformity, and 32.3% (n=31) had bone spurs, and 50% (n=69) had scoliosis/kyphosis deformity. Most patients may require shunt placement in the first year of life, and the need for shunts varies between 42.6% and 95.5%. The study by Erkoç et al. [7] in 2020 stated that ventriculoperitoneal (VP) shunt surgery was performed in 66.6% of the patients. Our study observed that shunt surgery was performed in 66.7% (n=64) of our patients, and our data were consistent with the literature.

The 1-year mortality rates reported in Uganda, Nigeria, and Tanzania ranged between 27% and 34% [18]. According to Western literature, these rates were reported between 1.4% and 6.8% [19]. In our study, the rate of deaths only in open spinal dysraphism patients was found to be 11.4% (n=11/96), which confirms the importance of early diagnosis and early surgery. When closed spinal dysraphism and open spinal dysraphism cases were compared, we found that the rates of hydrocephalus ($p < 0.001$), shunt requirement ($p < 0.001$), Chiari Malformation ($p < 0.001$), presence of scoliosis/kyphosis (p

<0.001), urological problems (p <0.001), gastrointestinal problems (p =0.001), additional TCS operation (p <0.001) and mortality (p =0.022) were statistically significantly higher in open spinal dysraphism cases.

The most common causes of closed spinal dysraphism in the literature are reported as split spinal cord malformations, lipomyelomeningocele, and neural plate adhesions causing TCS in the follow-up after intradural lipoma and myelomeningocele repair, in order of frequency. In addition, dermal sinus tract, epidermoid and dermoid inclusion tumors, and anterior sacral meningocele have been reported as less common associations in different sources. In the study by Görgülü et al. [20], 21 cases were examined. The rates of closed spinal dysraphism types were determined as thick filum terminale (76.1%), lipomyelomeningocele (38.0%), split spinal cord malformation (33.3%), and spinal dermal sinus (9.5%). In the study conducted by Baykal et al. [21] examined 59 cases, and the rates of closed spinal dysraphism types were determined as filum terminal lipoma 84.7% (n=50), lipomeningomyelocele 10.2% (n=6), intraspinal lipoma 5.1% (n=3) (105). In our study, we determined that the pathologies accompanying closed spinal dysraphism were thick filum terminale in 9 (21.4%) cases, dermal sinus tract in 11 (26.2%), diastometamyelia in 13 (31%), intradural lipoma in 4 (9.5%), filum terminale lipoma in 4 (9.5%), and neuroenteric cyst in 1 (2.4%), under the literature. Although there is no study on the subject in the literature, our findings show that cases that underwent additional TCS surgery in their follow-up after open spinal dysraphism surgery had statistically significantly more extended follow-up periods than cases that did not undergo surgery (p =0.006). We also found that follow-up periods were statistically significantly more extended between cases that underwent additional TCS surgery and those that underwent surgery for closed spinal dysraphism (p <0.001). In addition, we found that there were statistically significant differences in neurological examination rates between cases that underwent surgery for open spinal dysraphism and underwent and did not undergo additional TCS surgery (p =0.002), between cases that underwent additional TCS surgery and closed spinal dysraphism (p <0.001), and between cases that did not undergo additional TCS surgery and closed spinal dysraphism (p <0.001). We found that cases operated for open spinal dysraphism and without additional TCS surgery during follow-up had significantly higher shunt requirement (p =0.041) and mortality (p <0.001) rates compared to cases that underwent additional TCS surgery. Similarly, in the comparison between cases that underwent additional TCS surgery and closed spinal dysraphism cases, we found that hydrocephalus (p <0.001), shunt requirement (p <0.001), Chiari Malformation (p <0.001), presence of scoliosis/kyphosis (p <0.001), urological problems (p <0.001), and gastrointestinal problems (p =0.002) rates were significantly higher. Similarly, in the comparison between cases without additional TCS operation and closed spinal dysraphism cases, we observed that hydrocephalus, shunt requirement, Chiari Malformation, presence of scoliosis/kyphosis, urological problems, gastrointestinal problems, and mortality rates were statistically significantly higher (p <0.001).

CONCLUSION

The results obtained show that open and closed spinal dysraphism cases have significant differences in follow-up periods, clinical courses and complication profiles. In particular, it was observed that cases that underwent additional TCS surgery following open spinal dysraphism surgery had significantly more extended follow-up periods, and those who did not undergo additional TCS surgery had substantially higher shunt requirements and mortality rates. In addition, it was determined that open spinal dysraphism cases were more prone to certain complications than closed spinal dysraphism cases. At the same time, while closed spinal dysraphisms progress with milder symptoms, open spinal dysraphisms have the potential to cause quite severe neurological deficits.

These findings emphasize that patients diagnosed with open spinal dysraphism should be meticulously evaluated during follow-up after surgical intervention and long-term follow-up strategies should be determined meticulously so that additional surgical procedures can be performed at the appropriate time.

DESCRIPTIONS

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AI Statement

The authors used AI and AI-assisted Technologies (Grammarly and MS Word Editor) in the writing process. These technologies improved the readability and language of the work. Still, they did not replace key authoring tasks such as producing scientific or medical insights, drawing scientific conclusions, or providing clinical recommendations. The authors are ultimately responsible and accountable for the contents of the whole work.

Competing interests

The authors declare that they have no competing interests.

Consent for Publication

The original article is not under consideration by another publication, and its substance, tables, or figures have not been published previously and will only be published elsewhere.

Data Availability

The data supporting this study's findings are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Ethical Declaration

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Our institution has granted ethics committee approval with protocol number 2011-KAEK-25 2023/03-07. As this was retrospective research, no informed consent was obtained from participants.

REFERENCES

1. Sinha A, P P, Chakraborty H, Barnwal RK, Sinha R. Burden of neural tube defects in India: a systematic review and meta-analysis. Childs Nerv Syst. 2024;40(12):4123-4135. doi:10.1007/s00381-024-06627-x

2. Aydin S, Jenkins A, Detchou D, Barrie U. Folate fortification for spina bifida: preventing neural tube defects. Neurosurg Rev. 2024;47(1):724. Published 2024 Oct 4. doi:10.1007/s10143-024-02959-z

3. Gebremariam BM, Hailu D, Stoecker BJ, Mulugeta A. Birth prevalence and determinants of neural tube defects among newborns in Ethiopia: A systematic review and meta-analysis. PLoS One. 2025;20(1):e0315122. Published 2025 Jan 2. doi:10.1371/journal.pone.0315122

4. Karuparti S, Dunbar A, Varagur K, et al. Predictors and timing of hydrocephalus treatment in patients undergoing prenatal versus postnatal surgery for myelomeningocele. J Neurosurg Pediatr. 2024;33(6):544-553. Published 2024 Mar 8. doi:10.3171/2023.10.PEDS23327

5. Fareed A, Farhat S, Kerhani AA, Choudhary A, Raza SSM. Fetal in-utero management of myelomeningocele: a mini-review on history, challenges, management gap, and recommendations. Ann Med Surg (Lond). 2024;86(6):3196-3198. Published 2024 Apr 19. doi:10.1097/MS9.0000000000002061

6. Tomatir AG, Kiray Vural B, Acikbas I, Akdag B. Registries of cases with neural tube defects in Denizli, Turkey, 2004 2010. Genet Mol Res. 2014;13(4):8537 43.

7. Erkoç YS, Erdem Y, Bayar MA. Retrospective Evaluation of Surgically Treated Patients with Myelomeningocele. Journal of Ankara University Faculty of Medicine. 2020; Vol. 73, Issue 1

8. McCarthy DJ, Sheinberg DL, Luther E, McCrea HJ. Myelomeningocele-associated hydrocephalus: nationwide analysis and systematic review. Neurosurg Focus. 2019;47(4):E5. doi:10.3171/2019.7.FOCUS19469

9. Sert, O. Retrospective evaluation of cases that underwent meningocele and meningomyelocele surgery. Medical Specialization Thesis. Necmettin Erbakan University Institutional Academic Archives. Meram Faculty of Medicine, Department of Surgical Medical Sciences, Department of Neurosurgery, Konya.2021.

10. Baskurt O, Hicdonmez T, Gazioglu MN. Aberrant Dorsal Nerve Root as a Concomitant Cause of Spinal Cord Tethering Associated with a Dorsal Type Lipomyelomeningocele in a Child With Caudal Agenesis. Niger J Clin Pract. 2024;27(4):537-540. doi:10.4103/njcp.njcp_838_23

11. Bülbül A,Can E, Uslu S, Kıray Baş E, Şahin Y, Yılmaz A, Nuhoğlu A. Effect of operation time on prognosis and defined additional anomalies among neonatal meningomyelocele cases. The Medical Bulletin of Sisli Etfal Hospital. 2009.

12. Demir Ö. Retrospective evaluation of neonatal patients treated with the diagnosis of lumbosacral meningocele or meningomyelocele, Van Med J. 2019: 34-38; 26–1, doi.org/10.5505/vtd.2019.82335

13. Edström E, Wesslén C, Fletcher-Sandersjöö A, Elmi-Terander A, Sandvik U. Filum terminale transection in pediatric tethered cord syndrome: a single center, population-based, cohort study of 95 cases. Acta Neurochir (Wien). 2022;164(6):1473-1480. doi:10.1007/s00701-022-05218-6

14. Tortori-Donati P, Rossi A, Cama A. Spinal dysraphism: a review of neuroradiological features with embryological correlations and proposal for a new classification. Neuroradiology. 2000;42(7):471-491. doi:10.1007/s002340000325

15. Findlay MC, Tenhoeve S, Terry SA, et al. Disparities in indications and outcomes reporting for pediatric tethered cord surgery: The need for a standardized outcome assessment tool. Childs Nerv Syst. 2024;40(4):1111-1120. doi:10.1007/s00381-023-06246-y

16. Hsieh P, Apaydin E, Briggs RG, et al. Diagnosis and Treatment of Tethered Spinal Cord: A Systematic Review. Pediatrics. 2024;154(5):e2024068270. doi:10.1542/peds.2024-068270

17. Karsonovich T, Alruwaili AA, Das JM. Myelomeningocele. In: StatPearls. Treasure Island (FL): StatPearls Publishing; November 21, 2024.

18. Xu LW, Vaca SD, He JQ, Nalwanga J, Muhumuza C, Kiryabwire J. Neural tube defects in Uganda: follow up outcomes from a national referral hospital. Neurosurg Focus. 2018;45(4):E9.

19. Phillips BC, Gelsomino M, Pownall AL, et al. Predictors of the need for cerebrospinal fluid diversion in patients with myelomeningocele. J Neurosurg Pediatr. 2014;14(2):167-172. doi:10.3171/2014.4.PEDS13470

20. Görgülü A, Çobanoğlu S, Hundemir C, Yanık B. Tethered Spinal Cord Syndrome Dusunen Adam The Journal of Psychiatry and Neurological Sciences. 2000;13:49 55.

21. Baykal D, Özmarasalı AI, Taşkapılıoğlu Ö. Our Clinical Experience in Surgical Treatment of Lumbosacral Lipomas. Uludağ University Faculty of Medicine Journal. 2022;48 (1) 49-52.