**Araştırma Makalesi /** *Research Article*

## WHAT ARE THE FACTORS EFFECT ON LENGTH OF STAY IN REHABILITATION UNIT IN SPINAL CORD INJURY PATIENTS?

## SPİNAL KORD YARALANMASI HASTALARINDA REHABİLİTASYON ÜNİTESİNDE KALMA SÜRESİNE ETKİSİ OLAN FAKTÖRLER NELERDİR?

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## ÖZ

***Giriş:*** *Bu çalışmanın amacı, Omurilik yaralanması (OY) olan hastalarda rehabilitasyon ünitesinde kalış süresini (KS) etkileyen ana klinik ve fonksiyonel faktörleri değerlendirmek ve komplikasyonların KS üzerindeki etkisini araştırmaktır.*

***Gereç ve Yöntem:*** *Örneklem, yatarak rehabilitasyon ünitesine başvuran 59 OY hastasından oluşuyordu. Demografik, klinik ve fonksiyonel özellikler, KS, tıbbi komplikasyon sayısı ve tipleri belirlendi. LOS ile ilgili faktörleri bulmak için korelasyon analizi yapıldı. KS'yi etkileyen bağımsız faktörleri ve bu faktörlerin KS değişimini ne ölçüde açıkladığını belirlemek için regresyon analizi yapıldı.*

***Bulgular:*** *İdrar yolu enfeksiyonu, nöropatik ağrı ve basınç ülseri, KS ile ilgili komplikasyonlar olsa da, regresyon analizinde komplikasyon sayısı ve FIM etkinliği, KS'nin bağımsız prediktif faktörleri olarak belirlenmiştir. Tek başına komplikasyonların hiçbiri, KS için bağımsız belirleyici olarak bulunmadı. Ancak, regresyon modeli LOS'taki varyasyonun sadece% 37.8' ini açıklayabildi.*

***Sonuç:*** *Komplikasyon sayısı, KS'nin ana belirleyicisidir. KS arttıkça günlük fonksiyonel kazanç azalır. Bu nedenle, gelecekteki çalışmalar, komplikasyon sayısının rolünü ve KS'yi etkileyebilecek diğer olası faktörleri belirlemek için gereklidir.*

## SUMMARY

***Introduction:*** *The objective of this study is to evaluate the main clinical and functional factors influencing the length of stay (LOS) in rehabilitation unit and to explore the effect of complications on the LOS in patients with Spinal Cord Injury (SCI).*

***Material and Methods:*** *The sample, who were admitted for inpatient rehabilitation unit consisted of 59 patients with SCI. Demographic, clinical, and functional characteristics, LOS, number and types of medical complications were determined. To find out the factors related to the LOS, correlation analysis was performed. Regression*

*analysis was also carried out to determine the independent factors affecting the LOS and the extent to which these factors explain the change in LOS.*

**Results:** *Although, the urinary tract infection, neuropathic pain and pressure ulcer were the complications related to the LOS, in regression analysis, the number of complications and the FIM efficiency were determined as independent predictive factors of the rehabilitation LOS. None of the complications alone was found to be the independent predictor for the LOS. However, the regression model was able to explain only 37.8% of the variation in the LOS.*

**Conclusion:** *The number of complications is the main determinant of the LOS. The daily functional gain decreases as the LOS increases. Thus, future studies are necessary to determine the role of the number of complications and possible other factors that may have an impact on the LOS.*

## INTRODUCTION

As the spinal cord injury (SCI) is an important cause of permanent functional disability, the studies have been focused on the factors affecting functional outcome and length of stay (LOS) at rehabilitation unit (1).

The LOS is one of the important factors affecting the rehabilitation efficiency. However, there are only a few studies assessing the factors that influence the LOS in patients with SCI. In these studies, comorbidities, assistive device requirements and complications have been reported to be associated with the LOS (2, 3). Factors that affect the LOS may also vary according to the characteristics of different rehabilitation units in the same country. Determining the factors that affect the LOS may lead to reducing treatment costs, to achieve the rehabilitation goals, and and may prevent from the complications related to prolonged hospital stay. This retrospective and descriptive study aimed to identify the factors affecting the LOS in SCI patients. We hypothesized that; complication number is one of the determinant factors affect on the LOS and the rehabilitation efficiency decrease as the LOS increase.

### Methods

This retrospective study consisted of patients with SCI (both traumatic and non-traumatic) enrolled in the rehabilitation unit. The study was approved by the local ethical committee. The study was conducted in accordance with the principles of the Declaration of Helsinki.

The data on first admissions to our hospital were included in the study. Patients with the lack of information in terms of the neurological, functional status and medical complications were excluded from the study. The patient pool

consists of 85 patients with SCI, but only 68 patients were included because of the data deficiencies stated above in this study. The patients who were discharged or transferred to another clinic/hospital within the first 10 days were excluded since they did not included in effective rehabilitation program. Eventually, the medical records of 59 patients included in the statistical analyses.

The demographic profile of the patients, the etiology of the SCI, SCI duration (months from injury to rehabilitation unit admission), and the LOS (days) in the rehabilitation unit were recorded. The LOS was defined as the period between admission to the rehabilitation center and final discharge to the patient's home or a nursing home. The severity of injury of all patients, based on the "American Spinal Injury (ASIA) Impairment Scale" (AIS) (4) and their ambulation status as defined by the functional ambulation scale (FAS) were recorded both at admission and at discharge. The patient's level of independence in daily living activities was assessed using the Functional Independence Measurement (FIM) score obtained by the Turkish adapted version of the FIM both at the time of admission to the rehabilitation unit and at discharge (5). FIM were scored by relevant members of the team within 72 hours of admission and before discharge. The change in the FIM score was determined by calculating the difference between the FIM scores at discharge and admission. The "FIM efficiency" score was calculated by dividing the "FIM gain" value by the LOS in the hospital (6). Complications present at the time of admission and/or those that arose during the stay in the rehabilitation unit were noted. The medical complications of all patients during hospital stay were determined. Medical complications included spasticity, neuropathic

pain, contracture, pressure ulcer, urinary tract infection (UTI), heterotopic ossification (HO), deep venous thrombosis (DVT), orthostatic hypotension. UTI was diagnosed as positive urine analysis and culture alongside with the supporting clinical signs of UTI including, fever, incontinence, malodorous urine, worsening spasticity, pain, leucocytosis. The number of complications (NC) developed during inpatient rehabilitation of the patients were recorded. Bladder drainage methods at the time of admission to rehabilitation unit were divided into three groups; indwelling catheter (IC), clean intermittent catheterization (CIC), and spontaneous voiding. Bladder drainage type was enumerated as follows: IC, 1; CIC, 2; spontaneous voiding, 3. The bowel continence status of the patients was recorded as incontinent or continent.

## Statistical analysis

The Statistical Package for Social Sciences (SPSS) for Windows 20 (IBM SPSS Inc., Chicago, IL) software was used for the statistical analysis. The normality of the data was evaluated by using the Kolmogorov–Smirnov test. Numerical variables that had a normal distribution were presented as mean ± standard deviation, and the others as medians (min–max). Categorical variables were presented as numbers and percentages. Paired-t test or Wilcoxan sign test, which one was appropriate, was used to assess the changes in variables during LOS. To evaluate the relationships between numerical variables, Pearson's or Spearman's correlation analysis was used according to normality distribution. Point biserial correlation analysis was used to evaluate the correlation between numerical and categorical variables, and between numerical and ordinal variables. Biserial correlation analysis was used to evaluate the correlation between numerical and ordinal variables. Stepwise linear regression analysis was used to detect possible independent predictive factors for the LOS. The model of best fit was chosen based on the $R^2$ regression coefficients. Before regression analysis, logarithmic transformation was performed to normalize the variables that did not have a normal distribution. Logarithmic transformation was performed after adding '1' to the values. For statistical significance, a value p<0.05 was used.

## RESULTS

The records consisted of 33 (55.9%) traumatic SCI patients and 26 (44.1%) non-traumatic SCI patients. The causes of injury in traumatic SCI patients were motor vehicle accidents (n=15), falls (n=14) diving (n=1), gunshot wounds (n=2), and other causes (n=1). The causes of injury in non-traumatic SCI patients were degenerative disc disease (n=11), infections (n=4), vascular pathology (n=4), spinal tumors (n=3), transverse myelitis (n=2), and other causes (n=2). The demographic and clinical characteristics of SCI patients are shown in Table 1. The median of LOS was 35 days.

**Table 1**. Demographic and clinical characteristics of the study group

| | |
|---|---|
| All study group, *n* | 59 |
| Age | 48.75 ± 18.7 |
| Gender *(Female), n (%)* | 20 (33.8) |
| SCI duration, *months* | 2.71 (0.25-120) |
| Etiology *(Traumatic), n (%)* | 33 (55.9) |
| Neurologic level of injury,*n (%)* | |
| Tetraplegia | 15 (25.4) |
| Paraplegia | 44 (74.6) |
| AIS impairment at admission, *n (%)* | |
| A | 10 (8.5) |
| B | 5 (8.5) |
| C | 26 (44.1) |
| D | 18 (30.5) |
| E | 0 (0) |
| AIS impairment at discharge, *n (%)* | |
| A | 9 (15.3) |
| B | 6 (10.2) |
| C | 24 (40.7) |
| D | 18 (30.5) |
| E | 2 (3.4) |
| Bladder drainage type, n *(%)* | |
| Indwelling catheter | 36 (61) |
| CIC | 5 (8.5) |
| Spontaneous voiding | 18 (30.5) |
| Bowel continence, *n (%)* | |
| Incontinence | 23 (39) |
| Continence | 36 (61) |

Numerical variables are shown as median (min-max) or mean ±SD

Categorical variables are shown as number (%)SCI; Spinal cord injury, AIS; American Spinal Injury Impairment Scale, IC; indwelling catheter, CIC; clean intermittent catheterization

Statistically significant functional recovery indicated by the FIM change scores was determined in both traumatic, and non-traumatic SCI groups (p<0.001, paired t test). The FAS score showed also a statistically significant improvement during rehabilitation period (p<0.001, Wilcoxan sign test). There was not any statistically significant difference between Traumatic and non-traumatic SCI patients groups in terms of the LOS (p=0.452, Man-Whitney U test). The most common complications were UTI and neuropathic pain, followed by spasticity and pressure ulcer. Clinical, functional characteristics, and complication types of SCI patients are shown in Table 2.

No significant correlation was found between the LOS and age, gender, neurological level of the injury, bowel continence, SCI duration, and the etiology of spinal cord injury. The LOS was correlated negatively with the FIM admission score, AIS classification, and FAS admission. Patients who were more dependent on urine drainage at admission to the hospital were more likely to stay in hospital more. Although the LOS was positively correlated with FIM change score, it was found to be in negative correlation with FIM efficiency score. Correlation analysis results between the LOS and demographic and clinical characteristics are shown in Table 3.

The LOS was positively correlated with the NC, pressure ulcers, UTI, the number of UTIs, and neuropathic pain. On the other hand, there was no significant correlation between the LOS and the presence of DVT, HO, orthostatic hypotension, contracture or spasticity. The correlation analysis results between the LOS and complications are shown in Table 4.

A stepwise multivariate regression model included bladder drainage type, FIM admission, FIM efficiency, pressure ulcer, NC, UTI number.

This model showed that the NC and FIM efficiency were the independent factors for predicting the rehabilitation LOS. The NC score was found to be the most important determinant of the LOS (β=0.425). On the other hand, none of the complication types was found to be an independent predictor for the LOS. The regression model was highly significant but explained only 37.8% of the variance of the LOS. The regression analysis results are shown in detail in Table 5.

**Table 2.** Functional characteristics, and the complications determined during staying inpatient rehabilitation unit of SCI patients.

| | |
|---|---|
| LOS (days), *median (min-max)* | 35 (11-100) |
| FIM admission *median (min-max)* | 64,5 (37-106) |
| FIM discharge *median (min-max)* | 76.2 (40-111) |
| FIM change *median (min-max)* | 8 (0-45) |
| FIM efficiency *median (min-max)* | 0.28 (0-1.45) |
| FAS admission, *median (min-max)* | 0.43 (0-4) |
| FAS discharge, *median (min-max)* | 1.33 (0-5) |
| NC *median (min-max)* | 2 (0-5) |
| UTI, *n (%)* | 34 (57.6) |
| Number of UTI *(IQR) median* | 1 (0-4) |
| Spasticity, *n (%)* | 20 (33.9) |
| Neuropathic pain, *n (%)* | 28 (47.5) |
| Pressure ulcer, *n (%)* | 20 (33.9) |
| Contracture, *n (%)* | 6 (10.2) |
| DVT, *n (%)* | 2 (3.4) |
| HO, *n (%)* | 5 (8.5) |
| Orthostatic hypotension, *n (%)* | 3 (5.1) |

Numerical variables are shown as median (min-max) Categorical variables are shown as number (%)

*p<0.05 accepted as statistically significance

SCI; Spinal cord injury, AIS; American Spinal Injury Impairment Scale, LOS; Length of stay, CIC; clean intermittent catheterization, UTI; Urinary tract infections, DVT; Deep venous thrombosis, HO; Heterotopic ossification, FIM; Functional independence measurement, NC; Number of complication

**Table 3.** Correlation analysis between LOS and demographic, clinical, and functional characteristics of patients

| | p | r |
|---|---|---|
| Age | 0.801 | -0.033[†] |
| Gender | 0.151 | -0.252[‡] |
| Neurologic level of injury | 0.108 | -0.212[‡] |
| Etiology | 0.143 | -0.193[‡] |
| SCI duration | 0.134 | -0.197 [φ] |
| AIS impairment at admission | 0.014 | -0.319[≠] |
| Urinary drainage type | **0.029*** | **-0.284[≠]** |
| Bowel continence | 0.927 | -0.012[‡] |
| FAS admission | **0.008*** | **-0.343[≠]** |
| FIM admission | **0.006*** | **-0.350[†]** |
| FIM change | **0.035*** | **0.275[†]** |
| FIM efficiency | **0.005*** | **-0.362** |

[†]: Pearson correlation,   [φ]: Spearman correlation, ≠: Biserial correlation coefficient, ‡: Point biserial correlation
LOS; Length of stay, SCI; Spinal cord injury, FIM; Functional independence measure, FAS; Functional ambulation scale, IC; indwelling catheter, CIC; clean intermittent catheterization, SCI; Spinal cord injury.
*p<0.05 accepted as statistically significance

**Table 4.** Correlation analysis between the LOS and the complications.

| | p | r |
|---|---|---|
| NC | **<0.001*** | **0.526 [φ]** |
| Pressure ulcer[a] | **0.007*** | **0.346[‡]** |
| UTI[a] | **<0.001*** | **0.450[‡]** |
| Number of UTI | **<0.001*** | **0.461 [φ]** |
| Neuropathic pain[a] | **0.032*** | 0.280[‡] |
| DVT[a] | 0.138 | 0.195[‡] |
| HO[a] | 0.545 | 0.099[‡] |
| Orthostatic hypotension[a] | 0.052 | 0,254[‡] |
| Contracture[a] | 0.412 | -0.109[‡] |
| Spasticity[a] | 0.055 | -0.681[‡] |

[φ]: Spearman correlation, ‡: Point biserial correlation
*p<0.05 accepted as statistically significance
LOS; Length of stay, DVT; Deep venous thrombosis, UTI; Urinary tract infections, HO; heterotopic ossification, NC; Number of complication.

**Table 5.** Regression model for the LOS and associated factors.

| | Unstandardized Coefficients | Standardized Coefficients | 95% Confidence   Intervals | | p |
|---|---|---|---|---|---|
| | B±SE | β | Lower | Upper | |
| Constant | 20.201±5.992 | | 8.197 | 32.205 | |
| NC | 48.149±9.600 | 0.425 | 28.918 | 67.379 | <0.001* |
| FIM efficiency | -19.498±7.265 | -0.281 | -34.051 | -4.945 | 0.010* |
| Adjusted $R^2$= 0.378; p=0.010 | | | | | |

B: Unstandardized regression coefficients; β Standardized regression coefficients; SE= standart error
NC: Number of complications
*p<0.05 accepted as statistically significance
**Logarithmic transformation performed for LOS.
LOS; Length of stay, FIM; Functional independence measure.

## DISCUSSION

In this study, our objective was to explore the factors affecting the LOS in SCI patients who were admitted to rehabilitation program. The two questions need to be answered in this study are: 1) Does LOS is associated with NC? and 2) Does rehabilitation efficiency decrease with increase in LOS? We found that while NC and FIM change were positively correlated with the LOS and FIM efficiency had a negative correlation. Considering the complications, we found that the UTI number, UTI, neuropathic pain, and pressure ulcer were positively correlated with the LOS. However, when the stepwise regression model was examined, only the NC and FIM efficiency were found to be independent determinants of the LOS. The regression model explained 37.8% of the variance of the LOS. This result indicates that NC is the main determinant among our variables for predicting the LOS. Also, this model showed a negative correlation between FIM efficiency and the LOS. This reveals that although FIM change continued to increase, the daily functional gain decreased with the prolonged LOS.

Studies have shown diverse results for the LOS in rehabilitation unit from 60 to 267 days in different countries (2, 7, 8). The median LOS was found to be 35 days in our study. The mean LOS was reported to be 52.1±25.5 days, in a recent report from our country (9). Another recent study reported that, the LOS was 76 days (10). The source of this inconsistency is unclear and might result from a difference in caseloads, healthcare systems, insurance coverage or a discrepancy in rehabilitation efficiency (8). The small number of specialized center and bed count in our country, make necessary determining the factors related to the LOS for effective use of the rehabilitation capacity. The differences in types and sources of the payers might be a driving factor for the LOS in different countries and this can explain in some extent the differences in the LOS. All of the patients enrolled to our rehabilitation unit had health insurance from Social Security Institution. Thus, the source of the payer cannot be a determining factor for the LOS in this study.

The relationship between the LOS and age, gender, etiology are conflicting. Post et al. found that the LOS was not different between the subgroups of age, gender, etiology and type of injury (8). Our results were consistent with these

reports, as we did not find any significant relationship between the LOS and age, gender, etiology of SCI. But also, there have been reports that had found significant association between the LOS and age (11). Injury severity, injury level, the degree of disability at admission, demographic properties, and complications were reported to be the responsible factors for the variability in the LOS (2, 7, 8, 12-14). In our study, there was no relationship between neurological level and LOS.

Most of the studies assessing the LOS had included only FIM change, but to comment on the efficiency of rehabilitation, FIM efficiency should also be assessed. Eastwood et al. reported that FIM admission is the strongest predictor for the LOS. Lower FIM admission scores had related to a higher LOS in their study (2). Osternhurn and Bode et al. stated that a poor functional status at admission was the most important factor for a longer LOS (14, 15). In addition, reports indicate that a prolonged LOS was strongly correlated with a worse functional outcome and the patients who stayed longer in a rehabilitation unit had an unfavorable functional outcome (10). However, Sattar et al. reported that the FIM gain was higher in patients with a longer LOS (16). Longer LOS in specialized SCI centers may even result in functional improvement (16). Mahmoud et al. reported that, the LOS was not a significant predictor for the FIM change, but FIM admission was the most strong contributor for FIM discharge (17). According to our data, although the FIM admission and FIM change score were correlated with the LOS, when the variables were included in the stepwise regression model, the significant determinant variables for the LOS were the FIM efficiency and NC. On the other hand, FIM change was not included to the regression model, because it had a strong correlation with FIM efficiency. In fact, this result shows that the NC is the most important factor in determining the LOS. Although the LOS is one of the most useful parameter for assessing rehabilitation outcome it may not be a perfect meter for assessing the rehabilitation efficiency (17). Therefore, if the primary endpoint is functional outcome; rehabilitation sessions, hours should be included to the analysis.

During the last decades, the decline in the LOS has been noticed in overall SCI subgroups. The developments of medical management

strategies, as well as the prevention of the complications can be the cause of this decline (18). The LOS is an indicator of global resource use and reflects the effectiveness of rehabilitation of a medical service. Our study results showed that, although functional improvement continues during stay in rehabilitation unit, functional gain achieved per day decrease as the LOS increases. Assessing the functional abilities during rehabilitation program and determining the time when functions reaches a plateau should be the main factor for improving the rehabilitation efficiency. Effective management of medical resources might result in a shorter LOS. Reducing the LOS takes an important place in respect to utilization of resources effectively and preventing patients from the undesirable effects of prolonged hospitalisation. In addition, only a few number of specialized center and insufficient bed count in our country make necessary determine the factors related to the LOS for effective use of the rehabilitation capacity. Reduction the LOS from 74 to 60 days for traumatic SCI has been reported to be related to worse outcomes and associated with hospital readmissions and discharge to nursing homes (2). Prolonged hospitalization in a more skilled center may be effective to promote the extended daily living activities, socialization, occupational activities etc.

There are only a few studies evaluating the effects of the complication types and numbers on the LOS. Similar to our results, Post et al. reported; although complication types were in correlation with the LOS, none of them was an independent predictor for the LOS (8). On the other hand, we included the NC as a variable, in our study. Post et al. also reported that the LOS was negatively correlated with functional outcome (8). Recently, Stampas performed a retrospective study of 110 traumatic SCI patients admitted for inpatient rehabilitation. The author found that, UTI number was associated with the LOS and the patients with acquired UTI had lower FIM scores (admission, discharge and efficiency). The patients with acquired UTI had longer LOS than the ones without UTI (19). Similarly, UTI was the most prevalent complication (57.6%) in our study group, but it was not found as an independent predictor for the LOS. The lack of association between UTI and LOS in our study, may be explained by the presence of longer time elapsed from the injury

time to the admission to our rehabilitation center than the Stampas' study group (19). As known, during the acute injury phase, the immune system become compromised in patients with SCI (20). In addition, in acute-subacute phase of SCI, acquired UTI may delay the diagnostic and management methods such as urodynamic study, transfer from indwelling catheter to intermittent catheterization.

In our report, although UTI, pressure ulcer and neuropathic pain were in correlation, regression analysis results showed that none of the complications particularly associated with the LOS. There would be a significant cumulative effect of increased number of complications over the LOS. So, the processes that the functional improvements still proceed and the factors that result in prolonged LOS should be separated from each other. Thus, determining the correct time for discharge from the rehabilitation unit with less complications and favorable functional improvement might become possible.

Our study had certain limitations. It was a retrospective study. Data were obtained from patient charts. The patient population was small and heterogeneous. We had only total FIM scores and, therefore, items that contributed to the total FIM scores were unavailable. There was no record regarding the loss of therapy sessions during stay in rehabilitation unit. The discharge setting (preinjury place or nursing home etc.), social factors, and cultural and family factors might be important factors in determining non-medical reasons of discharge decision which affect the LOS.

**CONCLUSION**

Achieving a targeted functional status with fewer complications and an optimal LOS are the key determinants for the effective rehabilitation. The determination of the LOS is important for insurance companies in many countries as well as patient and caregiver expectation. We found that although the NC was associated with the LOS, FIM efficiency decreased as the LOS increased. Although the functional gain tends to be improved during inpatient rehabilitation, daily functional improvement decreased. Assessing FIM efficiency periodically during stay in rehabilitation unit may help for more effective rehabilitation. Also preventing the complications will be one of the main determinats for effective rehabilitation and optimal LOS.

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