

# Rehabilitation Results of Patients with Traumatic Brain Injury

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## ABSTRACT:

Rehabilitation results of patients with traumatic brain injury

**Objective:** The aim of this study is to investigate the effectiveness of neurological rehabilitation in patients with traumatic brain injury.

**Materials and Method:** Forty-five patients who were rehabilitated after traumatic brain injury were included in the study. The sociodemographic characteristics of the patients, the cause of the injury, the duration of coma and posttraumatic amnesia, the duration of stay in the other clinics after injury, the time between injury and admission to the rehabilitation clinic, the duration of stay in the rehabilitation clinic and long-term complications were determined. The functional differences between the admission of the patients and their final control examinations were compared using Disability Rating Scale (DRS), Functional Independence Measure (FIM), and Functional Ambulation Scale (FAS), and cognitive differences were compared using their recent status criteria, with Rancho Los Amigos Scale (RLAS).

**Results:** There was a significant improvement in the functional status of patients after neurological rehabilitation. There were statistically significant changes in DRS, FIM, FAS and RLAS scores after treatment compared to initial status. Better improvement in the functional status was detected in patients with lower initial DRS scores and higher FIM and RLAS scores.

**Conclusion:** The neurologic rehabilitation significantly affects the recovery of functional status after traumatic brain injury.

**Keywords:** Traumatic brain injury, rehabilitation, functional status

## ÖZET:

Travmatik beyin hasarlı hastalarda rehabilitasyon sonuçları

**Amaç:** Travmatik beyin hasarlı hastalarda nörolojik rehabilitasyon etkinliğini arařtırmak.

**Garaç ve Yöntem:** Çalışmaya travmatik beyin hasarı sonrası rehabilite edilen 45 hasta alındı. Hastaların sosyodemografik özellikleri, yaralanma nedeni, koma süresi, posttravmatik amnezi süresi, yaralanma sonrası diđer kliniklerde kalıř süresi, yaralanma ile rehabilitasyon kliniğine yatıř arasındaki süre, rehabilitasyon kliniğinde kalma süreleri ve uzun dönem komplikasyonları belirlendi. Hastaların kliniğimize ilk yatıřları ile son kontrolleri arasındaki fark fonksiyonel açıdan; Özürlülük Derecelendirme Ölçütü (Disability Rating Scale, DRS), Fonksiyonel Bağımsızlık Ölçütü (Functional Independence Measure, FIM) ve Fonksiyonel Ambulasyon Skalası (FAS), bilişsel açıdan ise Rancho Los Amigos bilişsel fonksiyon düzeyleri skalası (RLAS) son durum ölçütleri kullanılarak karşılaştırıldı.

**Bulgular:** Nörolojik rehabilitasyon sonrasında hastaların fonksiyonel durumlarında belirgin iyileşme oldu. Başlangıç ve tedavi sonrası DRS, FİM, FAS ve RLAS skorlarında istatistiksel olarak anlamlı deęişimler oldu. Başlangıç DRS skoru düşük, FİM ve RLAS skoru yüksek olanlarda fonksiyonel son durumun daha iyi olduđu tespit edildi.

**Sonuç:** Travmatik beyin hasarı sonrası nörolojik rehabilitasyon fonksiyonel son durumun daha iyi olmasını sağlamaktadır.

**Anahtar kelimeler:** Travmatik beyin hasarı, rehabilitasyon, fonksiyonel son durum

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## INTRODUCTION

Traumatic brain injury (TBI), is the transient or permanent neurological dysfunction of the central nervous system caused by an external force. Disability population ranges from physical disabilities to cognitive and behavioral, psychological and social defects. The type of the damage, its localization and its seriousness affect the severity of the situation, its course and the final state.

Traumatic brain injury is a common and important social problem. The incidence of TBI is rising with each passing year, mainly due to car accidents, violence and the effects of wars and sports injuries. The highest incidence is between 15 and 24 years and over 75 years. The reported incidence in developed countries is 150-200/100,000 per year (1).

Head trauma is a pathology that is lethal, causing injuries and requires long-term treatment and care, and is statistically the fourth most common cause of death (2).

The cause of about half of head traumas is the motor vehicle accidents, bicycle accidents or pedestrian-vehicle accidents. Fall accidents are the second most common cause of head traumas (21%), and are more common in older adults and young ones. Accidents of violence account for about 12% of all head traumas. Accidents during sports and recreation constitute 10% of TBIs (3). Traumatic Brain Injury (TBI) affects all age groups. However, complex problems arise in children with TBI, as trauma and biological, psychological and social development processes may interfere with each other. At the other end of the age spectrum, there are elderly adults with cerebral injuries who tend to heal more slowly than the young population and which may be complicated due to decreased plasticity of the aging brain and additional diseases present before injury.

Most of the cases require a long-term rehabilitation program. Younger patients may be more likely to recover than elderly patients because of the greater chance of plasticity in the young brain tissue. The final clinical condition will be determined by factors such as the age of the patient, the severity of the injury, the previous state of the brain tissue, and accompanying diseases.

The economic and social dimension of TBI is a serious problem. The patients, most of whom are young adults, suddenly become physically and socially disabled and disconnect from community life. Besides the significant loss of quality of life, the economical aspect of the situation is also a serious problem.

In recent years, evidence of the effectiveness of early rehabilitation in improving functional outcomes after TBI has been increasing (4-6). The ultimate goal of TBI rehabilitation is to help patients in maintaining meaningful participation in populations and social environment, despite certain limitations (7).

In our study, we aimed to investigate the efficacy of neurological rehabilitation in patients with TBI.

## MATERIAL AND METHOD

A total of 45 patients with traumatic brain injury who were rehabilitated between 2008 and 2013 in the Department of Physical Medicine and Rehabilitation of Necmettin Erbakan University, Meram Medical Faculty, were included in the study. Patients' age, sex, body mass index (kg/m<sup>2</sup>), marital status, level of education, level of income, social support, working status at the time of injury, alcohol use, cause of injury, duration of coma, duration of posttraumatic amnesia and duration of stay in the rehabilitation clinic were determined. Consciousness level, cooperation, orientation, speech, swallowing, sense, motor evaluation, tonus, walking, balance, coordination, pain, gait and urinary incontinence examinations were recorded. The functional differences between the admission of the patients and their final control examinations were compared using Disability Rating Scale (DRS), Functional Independence Measure (FIM), and Functional Ambulation Scale (FAS), and cognitive differences were compared using their recent status criteria, with Rancho Los Amigos Scale (RLAS) (8-13).

DRS was used to determine the disability ratings of the patients. DRS has been specially developed for TBI and is designed to evaluate changes from coma to community life. This scale constitutes a quantitative disability index that separates severity from interobserver reliability and severity at 10 levels, and

is more sensitive to the clinical change than the Glasgow final status scale. Low scores in DRS indicate low disability, high scores indicate high disability. The total score obtained was collected in 10 groups. These groups are; no disability, mild, partial, moderate, moderate-serious, serious, very serious disability, vegetative period, full vegetative period and death (9).

The Rancho-Los Amigos Scale (RLAS) was used to determine cognitive status characteristics. RLAS is a measure used to assess prognosis with cognitive functions; neurobehavioral status levels are scored in 8 stages ranging from no response to purposeful-appropriate behavior. This scale classifies patients as low functional category (Ranchos 1-2), intermediate (Ranchos 3-6), and advanced (Ranchos 7-8) levels (14). Although it cannot accurately measure communicative and behavioral losses, it is a practical measure of the rehabilitation process of TBI.

The functional status was assessed by FIM. FIM analyzes two different directions of disability, namely motor and cognitive functions. FIM is concentrated in six functional areas; self-care, sphincter control, mobility, locomotion, communication and social perception. A total of 18 activities in the FIM are evaluated for functional independence using a 7-point scale for each. Total score is 126 (15).

The ambulatory evaluations of the patients were made by FAS: non-functional ambulation (level 0), assistance-dependent ambulation (level 1), assisted ambulation: intermittent assistance (level 2), supervisory-dependent ambulation (level 3), independent ambulation on flat ground (level 4) and independent ambulation (level 5).

The patients were evaluated before the beginning of neurological rehabilitation and at the end of rehabilitation. Consent and approval forms were obtained from the patient and/or relatives of the patient at the onset of the study. The study was approved by Necmettin Erbakan University Meram Medical Faculty ethics committee.

### Statistical Analysis

Descriptive statistics such as mean, standard deviation and frequency distributions were

**Table-1: Socio-demographic and pre-rehabilitation clinical characteristics of patients participating in the study**

<b>Age (Years)</b>	29.0±13.4 (6-54)
<b>Gender:</b>	
Female	13 (28.9%)
Male	32 (71.1%)
<b>BMI</b>	23.1±2.4 (19-29)
<b>Occupation</b>	
Occupied	34 (75.6%)
Unemployed	6 (13.3%)
House wife	5 (11.1%)
<b>Level of education</b>	
Non-literate	6 (6.7%)
Elementary school	11 (24.4%)
High-school	22 (48.9%)
Universtiy	9 (20%)
<b>Income rate</b>	
<900 TL	36 (80%)
900-2000 TL	7 (15.6%)
2000-4000 TL	2 (4.4%)
<b>Marital status</b>	
Married	13 (28.9%)
Single	29 (64.4%)
Divorced	3 (6.7%)
<b>Social support</b>	
Alone	1 (2.2%)
Spouse	12 (26.7%)
Family	31 (68.9%)
Other	1 (2.2%)
<b>Alcohol intake</b>	12 (26.7%)
<b>Cause of injury</b>	
Traffic accident	36 (80%)
Fall from high	4 (8.9%)
Other	5 (11.1%)
<b>Coma period (Days)</b>	48.5±42.9 (0-210)
<b>Posttraumatic amnesia period (Days)</b>	136.1±128.9 (0-450)
<b>Period at the rehabilitation clinic (Days)</b>	50.1±21.9 (12-110)

**Table-2: Losses and problems in traumatic brain injury**

Sense loss	11 (24.4%)
Paralysis	18 (40.0%)
Balance disorder	23 (51.1%)
Loss of coordination	21 (46.7%)
Communication problems	13 (28.9%)
Swallowing disorder	10 (22.2%)
Incontinence	10 (22.2%)
Epilepsy	6 (13.3%)
Pain	18 (40.0%)
Pressure injury	3 (6.7%)
Heterotopic ossification	3 (6.7%)
Spasticity	14 (31.1%)

performed in the study. Numerics and percentage distributions were given in determining the demographic and physical characteristics of the

**Table-3: Functional evaluation results**

	<b>Onset (Mean±Standard Deviation)</b>	<b>Control (Mean±Standard Deviation)</b>	<b>p value</b>
RLAS	4.8±1.8	7.4±1.0	p<0.001
FIM	45.7±28.2	99.6±30.0	p<0.001
FAS	1.2±1.3	3.8±1.3	p<0.001
DRS	14.6±7.7	4.2±5.0	p<0.001

**Table-4: The relationship between the duration of the coma and the functional last status (r)**

<b>Pearson Correlation</b>	<b>FIM Control</b>	<b>FAS Control</b>	<b>RLAS Control</b>	<b>DRS Control</b>
Duration of Coma	-0.449	-0.581	-0.433	0.396
Duration of PTA	-0.504	-0.560	-0.435	0.409
GCS at the beginning	0.399	0.367	0.331	-0.284
DRS at the beginning	-0.517	-0.414	-0.425	

patients. t-test was used in the comparison of the values of the first day of the rehabilitation and the control FIM, DRS, RLAS and FAS values. The relationship between the duration of post traumatic amnesia (PTA), duration of coma, baseline Glasgow Coma Scale (GCS), and FIM, DRS, RLAS and FAS was examined by Pearson correlation analysis. SPSS-16.0 software package program was used for statistical calculations and p<0.05 was considered significant.

## RESULTS

The total number of patients included in the study was 45. Socio-demographic characteristics and pre-rehabilitation clinical characteristics of patients on admission to our clinic are shown in Table-1.

Losses and problems seen after TBI in our patients are presented in Table-2.

Of the patients participating in the study, 13 (28.9%) returned to their pre-injury occupations while 5 (11.1%) were retired of disability and 4 (8.9%) were housewives.

Statistically significant improvements were found in FIM, DRS, RLAS and FAS values when the functional evaluations of our patients at onset and at the end were compared (Table-3).

The relationship between the duration of coma, the duration of PTA, the initial GCS values, and the initial DRS values of the patients and functional end-status are shown in Table-4.

## DISCUSSION

TBI is a major public health problem that can result in long-term disability or death. The profound effect of TBI is felt not only by injured individuals but also by caregivers and society. Early and intensive rehabilitation after an injury affects the functional end-state (16). In our study, patients who had neurological rehabilitation showed a significant improvement in their functional status. David et al. (17) showed that patients with a longer duration of PTA, a lower DRS score, a lower FIM score at the beginning of the rehabilitation had a longer duration of treatment, higher treatment costs, and worse functional outcomes. In our study, we also found that the functional end-stage of patients with a long duration of coma and a long PTA, low baseline FIM, DRS, and GCS values were worse. Sandhaug et al. (18) showed that outcome measures in the TBI study are more appropriate to assess functional recovery in the acute phase, than later stages of TBI recovery. Khan et al. (19) found in their study that 46.6% of the patients had headache, 35.9% had dizziness, 34% had incontinence, 34% had sensory impairment, 31.1% had paralysis, 29.1% had spasticity, 22.3% had dysphagia and 13.6% had epileptic seizures in long term following TBI. In our study also, 40% of the patients had headache, 51.1% had dizziness, 22.2% had incontinence, 24.4% had sensory impairment, 40% had paralysis, 29.1% had spasticity, 22.3% had dysphagia, 13.6% had epileptic seizure and 6.7%

had heterotopic ossification, being consistent with the literature. Evaluation of the possible complications of the patients during and after the rehabilitation process is important for the effectiveness of the rehabilitation and the functional improvement of the

patient. In our study, TBI was studied in terms of physical limitations, effectiveness of rehabilitation and long term complications. Further studies are necessary in order on the cognitive problems after TBI and rehabilitation of these problems.

## REFERENCES

1. Rimel RW, Jane JA, Bond MR. Characteristics of the Head Injured Patients In: Rosental M, Griffith ER, Bond MR, Miller JD (eds). *Rehabilitation of the Adult and Child with Traumatic Brain Injury. Second Edition Philadelphia FA Davis Company; 1990. p.8-17.*
2. Paşaoğlu A. Erişkinde Kafa Travmaları. *Temel Nöroşirürji Cilt I, Ankara: Türk Nöroşirürji Derneği Yayınları; 2005. p.316-23.*
3. Sloan S, Winkler D, Anson K. Long term outcome following TBI. *Brain Impairment 2007; 8: 251-61. [CrossRef]*
4. Hassett L, Moseley AM, Tate R, Harmer AR. Fitness training for cardiorespiratory conditioning after traumatic brain injury. *Cochrane Database Syst Rev 2008; Issue 2.*
5. De Silva M, MacLachlan M, Devane D, Desmond D, Gallagher P, Schnyder U, et al. Psychosocial interventions for the prevention of disability following traumatic physical injury. *Cochrane Database Syst Rev 2009; Issue 4.*
6. Turner-Stokes L, Nair A, Sedki I, Disler PB, Wade DT. Multi-disciplinary rehabilitation for acquired brain injury in adults of working age. *Cochrane Database Syst Rev 2005; Issue 3.*
7. Cicerone KD. Participation as an outcome of traumatic brain injury rehabilitation. *J Head Trauma Rehabil 2004; 19: 494-501. [CrossRef]*
8. Meray J. Travmatik beyin hasarında değerlendirme. *Türk Fiz Tıp Rehab Derg 2005; 51(Özel ek 8):30-4.*
9. Rappaport M, Hall KM, Hopkins HK. Disability Rating Scale for severe head trauma: coma to community. *Arch Phys Med Rehabil 1982; 63: 118-23.*
10. Hamilton BB, Laughlin JA, Fiedler RC, Granger CV. Interrater agreement of the seven-level Functional independence Measurement (FIM). *Scand J Rehabil Med 1994; 26: 115-9.*
11. Heinemann AW, Linacre JM, Wright BD, Hamilton BB, Granger C. Relationships between impairment and physical disability as measured by the functional independence measure. *Arch Phys Med Rehabil 1993; 74:566-73. [CrossRef]*
12. Holden MK, Kathlee MG, Magliozzi MR, Nathan J, Piehl Baker L. Clinical gait assesment in the neurologically impaired. *Rehabilitation and meaningfulness. Phys Ther 1986; 66: 1530-9. [CrossRef]*
13. Whyte J, Hart T, Laborde A, Rosenthal M. Rehabilitation of the patient with traumatic brain injury. In: DeLisa J, Gans BM, Bockenek WL, Currie DM, Geiringer SR, Gerber LH (eds) *Rehabilitation medicine: principles and practice. 3rd ed. Philadelphia: Lippincott-Raven; 1998. p. 1191-239.*
14. Mysiw WJ, Corrigan JD, Hunt M, Cavin D, Fish T. Vocational evaluation of traumatic brain injury patients using the functional assesment inventory. *Brain Injury 1989; 3: 27-34. [CrossRef]*
15. Kucukdeveci, A, Yavuzer G, Elhan A, Sonel B, Tennant A. Adaptation of the Functional Independence Measure for use in Turkey. *Clin Rehabil 2001; 15: 311-9. [CrossRef]*
16. Blackerby WF. Intensity of rehabilitation and length of stay. *Brain Inj 1990; 4: 167-73. [CrossRef]*
17. Cifu DX, Kreutzer JS, Marwitz JH, Rosenthal M, Englander J, High W. Functional Outcomes of Older Adults With Traumatic Brain Injury: A Prospective, Multicenter Analysis. *Arch Phys Med Rehabil 1996; 77: 883-8. [CrossRef]*
18. Sandhaug M, Andelic N, Langhammer B, Mygland A. Functional level during the first 2 years after moderate and severe traumatic brain injury. *Brain Inj 2015; 29: 1431-8. [CrossRef]*
19. Khan F, Amatya B, Judson R, Chung P, Truesdale M, Dip G. et al. Factors Associated With Long-term Functional And Psychological Outcomes In Persons With Moderate To Severe Traumatic Brain Injury. *J Rehabil Med 2016; 48: 442-8. [CrossRef]*