



## ARAŞTIRMA / RESEARCH

# Trunk control is related to functional status in patients who underwent surgery for brain tumor

Beyin tümör cerrahisi geçiren hastalarda gövde kontrolü fonksiyonel durumla ilişkilidir

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### Abstract

**Purpose:** Trunk control is the key component for functional movements and affected by limited blood circulation in neurological diseases. Although the relationship between trunk control, gait and functional independence is clear neurological conditions as stroke, it is not known in patients who underwent surgery for brain tumor. The aim of this study is to determine the relationship between trunk control, functional independence and functional capacity in patients with brain tumors early period after surgery.

**Materials and Methods:** Trunk control, functional mobility and independence of twelve patients with brain tumor were evaluated by 2-Minute Walk Test (2MWT), Trunk Impairment Test (TIS) and Barthel Index, respectively in early postoperative period.

**Results:** Functional mobility was positively correlated with total and static trunk control ( $p=0.028$ ,  $r=0.629$  for total trunk control and  $p=0.029$ ,  $r=0.627$  for static trunk control). Functional independence was correlated to total trunk control ( $p=0.023$ ,  $r=0.674$ ).

**Conclusion:** Functional mobility was closely associated with trunk control and functional independence in patients with brain tumor early period after surgery. Intensive evaluation that targets trunk control early after surgery should be done to regain better functional mobility for functional independence.

**Keywords:** Trunk control, daily functions, tumor

### Öz

**Amaç:** Gövde kontrolü, fonksiyonel hareketler için önemli bir bileşendir ve nörolojik hastalıklarda sınırlı kan dolaşımından etkilenir. İnme gibi nörolojik durumlarda gövde kontrolü, yürüme ve fonksiyonel bağımsızlık arasında ilişkinin olduğu net olsa da, beyin tümörü nedeniyle ameliyat edilen hastalarda bilinmemektedir. Bu çalışmanın amacı, beyin tümörü olan hastalarda cerrahi sonrası erken dönemde gövde kontrolü, fonksiyonel bağımsızlık ve fonksiyonel kapasite arasındaki ilişkiyi belirlemektir.

**Gereç ve Yöntem:** Beyin tümörü olan on iki hastanın gövde kontrolü, fonksiyonel mobilitesi ve bağımsızlığı, sırasıyla Gövde Bozukluk Ölçeği, 2 Dakika Yürüme Testi, ve Barthel İndeksi ile postoperatif erken dönemde değerlendirildi.

**Bulgular:** Fonksiyonel mobilite, toplam ve statik gövde kontrolü ile pozitif yönde koreleydi (toplam gövde kontrolü için  $p=0.028$ ,  $r=0.629$  ve statik gövde kontrolü için  $p=0.029$ ,  $r=0.627$ ). Fonksiyonel bağımsızlık, gövde kontrolü toplam skoru ile ilişkiydi ( $p=0.023$ ,  $r=0.674$ ).

**Sonuç:** Fonksiyonel mobilite, beyin tümörü cerrahisi sonrası erken dönem hastalarda gövde kontrolü ve fonksiyonel bağımsızlık ile ilişkilidir. Fonksiyonel bağımsızlık için gereken fonksiyonel mobilitenin daha iyi sağlanması için, ameliyattan hemen sonra gövde kontrolünü hedef alan yoğun bir değerlendirme yapılmalıdır.

**Anahtar kelimeler:** Gövde kontrolü, fonksiyon, tümör

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## INTRODUCTION

Brain tumor is a neurological disease caused by a disturbance in blood supply to the brain. Brain tumors make up a significant portion of cancer and the incidence of brain tumors appears to be increasing in around of the world. The past three decades have seen a progressive increase in the incidence of cancer of the central nervous system particularly in elderly population<sup>1</sup>.

Patients with a brain tumor may exhibit motor deficits depending on tumor location, size, and type of treatment<sup>2</sup>. Sitting balance and selective trunk movements remain impaired after neurological diseases. Trunk control needs to be preceded in order to control distal limb movements and its correlated with functional movements. Trunk control is the ability to maintain the upright posture of the body, to adjust weight shifting and to perform selective movements in the trunk to maintain the center of mass within the base of support. Trunk control is also an indispensable basic motor ability for the execution of many functional tasks and trunk performance is important predictor of functional outcome in neurological diseases. Recent studies showed clear relations between trunk performance and measures of balance, gait and functional ability in neurological diseases. Motor deficit, along with limited trunk control, imbalance and gait impairment can generate significant degrees of patient dependency, which can interfere with QoL in patients with brain tumor<sup>3,4</sup>. Poor recovery of trunk performance may results in severe disability, limited mobility and reduced daily living activities in these patients.

Mostly, along with brain surgery is preferred approach to provide functional recovery in the patients with brain tumors, physiotherapy approaches are important for regaining functional independence in postoperative period and continuing treatment stage (radiotherapy and/or chemotherapy)<sup>5</sup>. Many patients and even clinicians would argue that prolonged functional independence is more important than prolonged survival with functional impairment. For that reason to gain trunk control, mobility and functional independence are important to decrease disability and increase the activities of daily living in these patients<sup>6</sup>. Trunk control is important in terms of neurorehabilitation which is used for stroke and other movement disorders (Parkinson etc.)<sup>7-10</sup>. Based on this knowledge, evaluation of early trunk control, mobility and functional independence in patients with brain tumors after surgery is so important in our clinical practice. We believe the assessment of these parameters may shed light the rehabilitation program of the patients with brain tumors to improve functional outcome early period after surgery.

Although the literature emphasizes the necessity of assessment early functional status in stroke patients, studies in patients with brain tumors early period after

surgery are few and limited<sup>9-12</sup>. Despite the evaluation of the functional mobility, independence and trunk control of patients with brain tumors have been well documented separately, their relations are not studied in the literature.

We hypothesized that trunk control would correlate with functional independence and functional capacity in patients who underwent surgery for brain tumor. The aim of this study was to determine the relationship between trunk control, functional independence and functional capacity in patients with brain tumors early period after surgery.

## MATERIALS AND METHODS

Fifteen patients with brain tumor who were hospitalized after brain surgery from May 2016 to September 2016 in Department of Neurosurgery at Dokuz Eylül University volunteered to participate in the study. One of the patients had underwent surgery for second time and two of them had reached instable clinical status, twelve patients were included the study. This cross-sectional prospective study was approved by the Ethics Committee of Dokuz Eylül University. All subjects gave their written informed consent before entering the study in accordance with the Declaration of Helsinki.

A sample of patients who was inpatient after brain surgery because of brain tumor was recruited according to the following inclusion criteria: 1. Being at the age of 18 years and over, 2. Being in stable clinical status (has stable vital signs), 3. Having score over 22 on The Mini Mental Test. Individuals with metastatic tumor (brain metastases in patients with metastatic breast, lung or many other type of the cancer) or any other neurological and musculoskeletal problems that affect functional mobility or independence were excluded.

### Assessment tools

Demographic and clinical information about age, body mass index (BMI), gender, anatomical localization of tumor, marital status, educational status and working status were recorded. Functional mobility was evaluated with 2-Minute Walk Test (2MWT), trunk control was evaluated with Trunk Impairment Test (TIS) and functional independence was evaluated with Barthel Index. The patients were evaluated in the Department of Neurosurgery within the first three days of the postoperative period (when clinical status was stable) and assessment of all participants was done early morning at their bedside by the physiotherapist (E.G.).

### 2-Minute Walk Test (2MWT)

It is a reliable method to assess functional mobility in neurological patients. The participants were instructed to 'walk as far as possible' on path in 2-minute. The total distance walked in 2 minutes was measured<sup>13</sup>. It

has shown that this test had excellent test-retest reliability as well as moderate construct validity for the evaluation of functional status in neurologic patients <sup>14</sup>.

### Trunk Impairment Test

The TIS measures the motor impairment of the trunk after a stroke through the evaluation of coordination of trunk movement, static sitting balance and dynamic sitting balance. Scores range from a minimum of 0 to a maximum of 23. Higher scores show better trunk control <sup>15</sup>. One study had shown that TIS use for the evaluation of body balance is valid and reliable for the Turkish population <sup>16</sup>.

### Barthel Index

The Barthel index was developed by Mahoney and Barthel in 1965. It is a simple and clear index that measures daily life activities. It consists of 10 subgroup including eating, bathing, self-care, dressing, bladder control, bowel control, toilet use, chair / bed transfer, mobility, use of stairs. The rating varies between 0-100 <sup>17</sup>. Barthel Index has been successful and it can be used in Turkey <sup>18</sup>.

### Statistical analysis

Statistical analysis was performed using the SPSS software version 20. The variables were investigated using visual (histograms, probability plots) and analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk's test) to determine whether or not they are normally distributed. Descriptive analyses were presented using means and standard deviations for normally distributed variables and were presented using medians and interquartile range (IQR) for the non-normally distributed and ordinal variables. While investigating the associations between non-normally distributed variables, the correlation coefficients and their significance were calculated using Spearman test. A p-value of less than 0,05 was considered to show a statistically significant result.

## RESULTS

The distribution of tumors according to localizations is shown in Table 1. Five (41.7 %) of 12 patients were female. The median age of the patients was 48.5 years and the median body mass index (BMI) was 26.04 kg/m<sup>2</sup> (Table 1). Descriptive characteristics of functional mobility, functional independence and trunk control of the patients are given in Table 2. The median 2-MWT score of the participants was 61 meters (Table 2). Functional mobility was positively correlated with total and static trunk control ( $p=0.028$ ,  $r=0.629$  for total trunk control and  $p=0.029$ ,  $r=0.627$  for static trunk control). There was a statistically significant relationship between functional mobility and functional independence ( $p=0.034$ ,  $r=0.641$ ). Functional independence was correlated to total trunk control ( $p=0.023$ ,  $r=0.674$ , Table 3).

**Table 1. Characteristics of the patients**

	Median (IQR)
Age (years)	48.5 (39.5-64.5)
BMI (kg/m <sup>2</sup> )*	26.04 (25.4-27.1)
Gender	n (%)
Female	5 (41.7%)
Male	7 (58.3%)
Tumor localization	
Frontal lobe	1 (8.3%)
Frontotemporal lobe	1 (8.3%)
Temporal lobe	2 (16.7%)
Temporarietal lobe	2 (16.7%)
Frontoparietal lobe	1 (8.3%)
Occipital lobe	1 (8.3%)
Parietal lobe	2 (16.7%)
Parietooccipital lobe	2 (16.7%)

\*BMI: body mass index, kg: kilogram, m: meter

**Table 2. Functional mobility, trunk impairment and functional independence scores of the patients**

	Median (IQR)
2 MWT (meters)	61.0 (38.25-85.5)
Trunk Impairment Scale	
Static	7.0 (6.0-7.0)
Dynamic	8.5 (6.0-10.0)
Coordination	6.0 (3.0-6.0)
Total	19.0 (15.5-22.75)
Barthel Index (score)	75.0 (60.0-95.0)

\*2 MWT: two minute walk test

**Table 3. Correlations between functional mobility, trunk impairment and functional independence**

	2 MWT	Barthel Index
2 MWT	N/A	$r=0.641$ $p=0.034$
Trunk Impairment Scale		
Static	$r=0.627$ $p=0.029$	$r=0.767$ $p=0.006$
Dynamic	$r=0.330$ $p=0.295$	$r=0.100$ $p=0.771$
Coordination	$r=0.401$ $p=0.196$	$r=0.726$ $p=0.011$
Total	$r=0.629$ $p=0.028$	$r=0.674$ $p=0.023$
Barthel Index	$r=0.641$ $p=0.034$	N/A

\*2 MWT: two minute walk test

## DISCUSSION

The purpose of the present study was to investigate the relationship between trunk control, functional mobility and independence in brain tumor patients during early period after surgery. Study results indicated that functional mobility was closely associated with trunk control and functional independence in patients with brain tumor early period after surgery and also this is the first study about relationship between trunk control and functionality in patients with brain tumor to the best of our knowledge. Trunk control (static control) was

correlated with functional mobility and functional independence as we specified our hypothesis.

Brain tumor causes impairment in physical functions and also activities that are necessary for independence at home and communal areas. For that reason, trunk is the core set to successfully perform gait and daily living activities. Our results indicated 'static trunk control' subscale score of TIS was significantly related to functional mobility. This subscale assesses the ability of the patient to stabilize her/his trunk in the base of support. Because of the stabilization is the key component for mobility, this relationship between static trunk control and functional mobility could verify that there is no functional gait without trunk stabilization. Functional mobility was not significantly related to 'Dynamic trunk control and coordination' subscale scores of TIS. Compensatory strategies during 2-minute walk test and poor performance on the dynamic sitting balance could be the reason for this finding as in stroke studies<sup>19-22</sup>.

Balance dysfunction following neurologic disease like stroke is common and sitting balance have been used as a prognostic indicator for motor recovery<sup>23</sup>. Verheyden et al., confirmed motor and functional recovery patterns after ischemic stroke was similar to trunk recovery pattern<sup>24</sup>. They also found that postural control was decreased and related to motor and functional performance (balance, upper extremity functions and daily activities) according to another study on chronic stroke<sup>25</sup>. Studies showed that there was a correlation between sitting balance and Barthel index score, and sitting balance and gait ability in neurologic disorders<sup>22,24-27</sup>. One study showed that trunk control, balance and gait were correlated with daily living activities and functions in patients with chronic stroke<sup>28</sup>. There is evidence in many studies that exercises such as core stability and proprioceptive neuromuscular facilitation improve trunk control, balance, gait and functional independence in patients with stroke<sup>29-31</sup>. Parallel to the literature that analyzed stroke patients, we found a significant relationship between 2-minute walk distance and Barthel Index Score in patients with brain tumor. These findings of the study suggest that to improve 2-minute walk distance for functional mobility may contribute to enhance functional independence. Although functional outcome of patients with brain tumor have been well documented, the functional mobility assessed by 2-minute walk test of these patients is not studied in the literature. For that reason, evaluating of functional mobility like based on meter or time performance tests is most important during early treatment in the patients with brain tumor surgery. Especially, this type of tests would be an important indicator for next rehabilitation stage.

In the present study trunk control, functional mobility and functional independence were measured using 2-Minute Walk Test, Trunk Impairment Scale and Barthel Index, respectively and measurement methods were designed based on the opinion of experts in the

field of neurological rehabilitation. These tools have the potential to guide suitable approaches in clinical practice.

Limitations of this study warrant caution when interpreting the results. The relatively small and selected group of patients included in the study challenges the generalizability of the outcome of this study. Further studies are needed to examine this association in large samples and specific tumor groups.

However this is the first study to report an association between trunk control and functional status in patients with brain tumor early period after surgery. The findings in this study support intensive evaluation that targets trunk control early after surgery should be done to regain better functional mobility for functional independence. Assessment and treatment of trunk control at an early stage after surgery is recommended to gain functional mobility and functional independence in patients with brain tumor.

**Yazar Katkıları:** Çalışma konsepti/Tasarımı: MST, EG, YŞ, OK; Veri toplama: EG, OK, MST; Veri analizi ve yorumlama: MST, EG, YŞ; Yazı taslağı: MST, EG, YŞ, OK; İçeriğin eleştirel incelenmesi: MST, EG, YŞ, OK; Son onay ve sorumluluk: MST, EG, YŞ, OK; Teknik ve malzeme desteği: EG, OK; Süpervizyon: MST, EG, YŞ, OK; Fon sağlama (mevcut ise): yok.

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