

## FİZİKSEL TIP

### ASSESSMENT OF GENU RECURVATUM IN HEMIPLEGIC PATIENTS

#### HEMİPLEJİK HASTALARDA GENU REKURVATUMUN DEĞERLENDİRİLMESİ

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#### SUMMARY

*Genu recurvatum (GR) is an extremely complex and debilitating deformity of the lower extremity in the rehabilitation patients. The aim of this study was to determine the relationship of GR with parameters such as balance, muscle strength, sensory and motor evaluation, early mobilization period, walking speed, walking distance in the hemiplegic patients. 30 stroke patients who were first attack of a cerebrovascular accident were recorded for this study. Balance, sensation, muscle strength, spasticity, range of motion of lower extremity of the hemiplegic patients were evaluated. Motor testing and mobility were assessed by using Fugl-Meyer scale, Rivermead Mobility Index (RMI) respectively. The angle of genu recurvatum is measured by lateral x-ray of the knee by loading in the standing position. In conclusion, statistically significant correlation was determined between GR and muscle weakness in knee extensors, spasticity, Fugl-Meyer motor scale.*

**Key words; genu recurvatum, hemiplegia, gait, stroke**

#### ÖZET

*Genu recurvatum, rehabilitasyon hastalarında alt ekstremitede görülen son derece kompleks ve zayıf düşürücü bir deformitedir. Bu çalışmanın amacı, hemiplejik hastalarda yürüme mesafesi, yürüme hızı, ilk mobilizasyon dönemi, duyu ve motor değerlendirme, kas gücü, denge gibi parametreler arasındaki ilişkiyi belirlemektir. İlk serebrovasküler atağı geçiren 30 hasta, bu çalışmaya kaydedildi. Hemiplejik hastaların alt ekstremitelerinin eklem hareket açıklıkları, spastisitesi, kas gücü ve denge değerlendirildi. Motor test ve mobilite Fugl-Meyer skala ve Rivermead Mobilite İndeksi kullanılarak değerlendirildi. GR açısı, ayakta yük verilerek çekilen lateral diz grafileriyle ölçüldü. Sonuçta, GR ve spastisite, Fugl-Meyer motor skala, diz ekstansörlerinde kas güçsüzlüğü arasında istatistiksel olarak belirgin bir korelasyon olduğu tespit edildi.*

**Anahtar Kelimeler; diz rekurvatumu, hemipleji, yürüme, strok**

#### INTRODUCTION

Genu Recurvatum (GR) is a common deformity of the lower limb in many rehabilitation patients. GR is an acquired deformity secondary to changes of the distal skeletal joint alignments and compensatory movement patterns. Musculoskeletal and upper motor neuron pathologies can lead to acquired GR (1). This deformity usually changes gait patterns (2). Decreased step length, stride length, velocity and cadance are primary gait alterations associated with GR. Increased lateral trunk displacement and increased energy costs also are likely to be noted (3). There are two types of recurvatum deformity which are dynamic and static knee recurvatum.

Hyperextension of the knee during the stance period is called dynamic recurvatum and occurs in patients with upper motor neuron pathology (4-5). Quadriceps weakness or spasticity, ankle plantar flexor weakness or spasticity, dorsiflexor weak-

ness and heel cord contracture may cause this atypic gait pattern (5).

Limb-length discrepancy, lesion of posterior capsule of the knee joint or posterior cruciate ligament, achilles tendon shortness, asymmetrical arrest of the proximal tibial physis may lead to static GR (6).

In this study, the relationship of GR with the parameters such as balance, muscle strength, sensory and motor evaluation, early mobilization period, walking speed, walking distance in the hemiplegic patients were investigated.

#### MATERIAL AND METHODS

From 2000 to 2001, 30 stroke patients who were admitted to Ankara Education and Research Hospital for medical rehabilitation were recruited for this study. Criteria for patient selection were:

1. Ability to understand and follow commands
2. First attack of a cerebrovascular accident and less than three months duration
3. Hemiplegia was not due to trauma, brain tumor or another secondary etiology
4. No articular contractures and fracture in the lower limb

Thirty patients (20 female, 10 male) meeting these criteria were included to the study. Age, sex, job, number of months since the stroke, type and site of the lesion according to Computerized Brain Tomography datas were recorded. Existence of the urinary incontinence and unconsciousness in the post-stroke period was asked. The passive range of motion was measured for all joints in the lower extremities, and muscle strength was tested manually and was graded on 1-5 scale (7).

**Table I.** The demographic characteristics of the study patients.

	Female	Male
n (%)	20(67%)	10(33%)
Age (mean) year	60±11.4	60±14.8
Disease duration (month)	26.6 ±53.26	38.30±35.27
Etiology		
• Hemorrhagic	4 (20%)	3 (30%)
• Thromboembolism	16 (80%)	7 (70%)
Affected side		
• Right	9 (45%)	3 (30%)
• Left	11 (55%)	7 (70%)

Sensory evaluation (moving light touch and proprioception) was performed in the hip, knee and ankle joints (8). The spasticity in the lower extremity was assessed in supine position by Ashworth scale (9). Balance was tested as described by Bohannon and associates. Motor recovery of the hemiplegic patients were evaluated by Brunnstrom stages (10).

Motor testing was assessed by modified Fugl-Meyer scale; hip flexion, knee flexion, knee extension and ankle dorsiflexion were tested in both sitting and standing positions (11). Patient motricity was then considered good or normal (2) with a score equal to or more than 14/18, impaired (1) with a score equal to or more than 3/18, or strongly impaired (0) with a score range from 0 to 2 (11).

Rivermead Mobility Index (RMI) was used to measure mobility in patients with stroke (12). The RMI comprises a series of 14 questions and one direct observation, and covers a range

of activities from turning over in bed to running. It is short, simple, and clinically relevant (13).

Maximum walking speed for 10 m distance was examined to evaluate walking speed. A recent study has revealed that the maximum walking speed for 10 m distance was a major determinant of activities for social life events among ambulatory post stroke patients (14).

To evaluate walking first of all patients' walking with an assistive device or not was observed. For walking distance, patients' walking less than 10 meters, 10 to 50 meters, or more than 50 meters at a time was recorded.

Anterior-posterior and lateral radiographs of the knee joint by loading in the standing position were examined for assessment of GR angle. In the lateral radiograph of patients angle between anatomic axis of femur and tibia was measured. Normally, this angle must be 180 degrees (Figure-1). GR angle up to -10 degree can be accepted as physiological (15). In our study, we accepted tibiofemoral angles less than this degree as GR. (Figure-2).

**Figure-1.** The view from lateral at extension of knee in the normal subjects.

**Figure-2.** The lateral x-ray of the knee of a patient with genu recurvatum.

**Graphic-1.** Lower limb muscle strength of patients.

SPSS software version 10 was used for statistical analysis. Spearman correlation test was performed to investigate the correlation among all values in the patient group. In the comparison inter groups, Mann-Whitney U test was used.

## RESULTS

The demographic characteristics of the patients were shown in the table I. Brain lesion was classified into 5 primary locations; lesion was in cortex in 21 (70 %) patients, in corona radiata in 1 (3%) patient, in internal capsule in 7 (22 %) patients, in putamen in 5 (16%) patients and in thalamus in 4 (13%) pa-

tients. 11 (36%) of the patients were reported to be unconscious during the event and 13 (43%) of the patients had urinary incontinence. Range of motion of lower extremity joints was normal in all of the patients.

Moving light touch was impaired in 4 patients and proprioception was normal in all patients.

The results of manual muscle testing were shown in the Graphic-1. There was no significant difference between knee extensor and flexor muscles strength those having or not having GR ( $p < 0.05$ ).

Stage of spasticity was in stage 1 in 7 (23%) patients, stage 2 in 18 (60%), stage 3 in 5 (17%). All patients had sitting balance. Standing balance was poor in only one patient. According to the Brunnstrom stage, the motor recovery of patients was in stage 2 in 1(3%) patient, in stage 3 in 8 (27%), in stage 4 in 15 (50%) and in stage 5 in 6 (20%) patients.

Fugl-Meyer motor testing was performed in the sitting position; 6 (20%) patients were in group 0 (strongly impaired), 24 (80%) in group 1 (impaired), no patient was in group 2 (good). When motor testing was performed in standing position, 6 (20%) were found in group 0, 22 (73%) in group 1, and 2 (7%) in group 2.

A significant correlation was found between the motor assessment results (performed both in sitting and standing position) and Brunnstrom stage ( $r: 0,674$   $p < 0,05$ ,  $r: 0,744$   $p < 0,05$ ) and RMI ( $r: 0,536$   $p < 0,05$ ,  $r: 0,600$   $p < 0,05$ ).

There was a significant correlation between the muscle strength and Brunnstrom stage, RMI, Fugl-Meyer scale, gait speed ( $p < 0.05$ ).

Of these patients, four (13%) were able to walk unaided, but twenty-six (87%) patients for ambulation used cane. One (3%) walked less than 10 meters in 1 go, 3 (10%) walked between 10 and 50 meters, 26 (87%) of them were able to walk more than 50 meters during a single trial. Twelve patients (40%) had a slow gait velocity (0,08-0,24 m/sn), 18 patients (60%) had an intermediate gait velocity (0,4-0,7 m/sn) and none of them had a normal gait velocity (1,04 m/sn) (16).

In the assessment of X-ray measurements of the GR angle, 15 (50%) patients had GR and 12 (40%) patients did not have GR.

Three patients were excluded in this study due to the fact that the knee x-rays were not taken by loading in extension and standing position. There is no significant relationship between GR and walking distance and speed (respectively  $r:0,007$   $r:0,105$   $p>0,05$ ). The each effect of GR on RMI and Brunnstrom stage was not determined ( $r:0,063$ ,  $r:0,056$   $p>0,05$ ).

The correlation of GR was statistically significant with knee extension muscle strength, knee spasticity, Fugl-Meyer motor scale and unconsciousness ( $r:0,34$ ,  $r:0,361$ ,  $r:0,360$ ,  $r:0,41$  respectively) (Table-II).

**Tablo II.** The parameters affecting genu recurvatum.

	<i>r</i>	<i>p</i>
Balance in standing	0,354	$p<0,05$
Unconsciousness	0,360	$p<0,05$
Walking distance	0,007	$p>0,05$
Walking speed	0,105	$p>0,05$
Muscle strength of knee extensor	0,340	$p<0,05$
Brunnstrom stage	0,056	$p>0,05$
Fugl Meyer scale	0,360	$p<0,05$
Spasticity of knee	0,356	$p<0,05$

## DISCUSSION

GR is an extremely complex and debilitating deformity of the lower limb. Some clinicians believe the problem is not important but other physicians say hyperextension is an important problem locking mechanism needed by the neurologically impaired adult for stability. This impairment has been reported in 46 % of patients with strokes and head injuries (2). In the 56% of hemiplegic patients were determined GR deformity in our study.

Patients learning to walk after stroke commonly present with impaired knee movement. Quantitative gait analysis has been used to evaluate the functional abilities of patients who have had a stroke. The ability to walk is the prime factor that determines whether a patient will return to the previous level of productivity after a stroke. The goals of stroke rehabilitation should be focused on retaining the ability to walk (16). Motor control, the sensation of proprioception, balance, sensory integration all demonstrated a significant effect on ambulation potentials (17). Of our patients, 13% were able to walk unaided, but 87% patients for ambulation used cane.

Bohannon et al showed that speed of gait does not seem to be affected by spasticity, in agreement with our experience (9). We found that walking speed of patients was low. There

was significant correlation between the motor and functional improvement of our hemiplegic patients and walking speed. We did not determine any effect of GR on the walking speed and distance.

In some patients, dynamic recurvatum can be advantageous due to providing an optimal knee control in the stance phase of gait cycle (5). This abnormality may occur in the amplitude, speed, or timing of knee extension during the gait cycle. Excessive speed or amplitude of knee extension during the stance phase of gait is abnormal whether the angle between tibial and femoral axes exceeds normal values (3).

In paralytic disorders, GR is initiated by muscle imbalances in gait that force the knee into hyperextension in stance phase. For example, when there is spasticity of the gastrosoleus that exceeds the spasticity of the hamstrings, the tibia is drawn backward as the gastrocnemius plantar flexes the foot against the floor. In poliomyelitis with quadriceps paralysis the knee is passively hyperextended so that the knee will not buckle in stance (18).

Hip flexion contractures or abnormal postural flexion at the hip can occur the ground reaction force anterior to the knee, and produce hyperextension forces. Hip extensor weakness may contribute to this problem. Quadriceps weakness can be developed by hyperextension of the knee. We showed that the spasticity and the quadriceps muscle weakness associated with GR.

The gastrocnemius muscle contracts strongly at the end of midstance, acting proximally to flex the knee and lift the heel to initiate propulsion. Mild spasticity and extensor synergy patterning can prevent normal contraction of gastrocnemius, causing extension at the knee (19).

Murphey et al. suggest that the normal range of motion of the knee joint might include 10-15 degree of hyperextension (20). Recurvatum that is primarily due to soft tissue abnormalities or muscle imbalances should be treated by appropriate muscle and soft tissue balancing procedures. With established bony deformity these also may require corrective osteotomies (18). In conclusion, the relationship was determined between GR and spasticity, muscle weakness in knee extensors, Fugl-Meyer motor scale.

The treatment of dysfunctional knee hyperextension is directed at the cause of the abnormal gait pattern. Hip extensor

strengthening, correction of hip flexor tightness and gait training to facilitate hip rotation may be helpful proximally. However the most effective treatment are applied at the foot and ankle. Proper knee motion in walking requires that the ankle be able to dorsiflex passively to at least neutral.

Ankle foot orthosis are very effective in reducing hyperextension at the knee. This orthosis can be attributed to maintain the foot in functional musculoskeletal alignment, to provide proprioceptive input, to allow stable weight bearing and to inhibit tonic supination of the foot due to spasticity and extensor synergy patterning (19).

Swedish knee cage is also used to control minor to moderate GR due to ligamentous or capsular laxity. Swedish knee cage allows full knee flexion and prevents hyperextension. Severe GR might need to be controlled with longer lever offered such as that offered by a KAFO (Knee ankle foot orthoses) (21).

If the recurvatum exceeds 10 degrees and if there are noticeable cosmetic and gait deviations, a corrective osteotomy is indicated (18).

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