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Research

Evaluation of Walking Disorders After Lower Extremity Fractures

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Abstract

Objective: This study was conducted to evaluate gait disturbances after lower extremity fractures.

Method: Socio-demographic and physical characteristics of all individuals participating in the study were recorded. Fracture histories of the cases were examined and recorded. Balance and walking of individuals were evaluated with tinetti balance and gait analysis, gait analysis with "Biodex Gait Trainer" system, and fear of movement with Tampa kinesiophobia scale.

Results: The mean age of 21 participants (8 women and 13 men) included in the study was 44.53±8.12 years, and body mass index was calculated as 27.40±3.89 kg/m2. The results of the measurements were analyzed by comparing the three fracture groups. According to the findings, the kinesiophobia of the femur fracture group, the stance phase score and the tinetti balance walking test score of the tarsal fracture group were significantly worse than the other groups. ($p<0.05$)

Conclusion: According to the results of the study, functional scores may vary as a result of fractures in different regions and different bones of the lower extremity.

Keywords: *Femoral fractures, tibia fractures, Gait Analysis, Gait.*

Introduction

Fracture occurs with partial or complete disruption of the integrity of the bone. Fractures can be classified in many different ways and may develop due to different reasons. Lower extremity fractures account for one-third to half of total fractures, leading to increased morbidity and mortality rates.[1] Most lower extremity fractures are closed fractures, meaning the integrity of the skin over the fracture is intact and the risk of infection is low. In open fractures, on the other hand, since the skin integrity is impaired, the area is exposed to contamination and this increases the risk of complications.[2] Fracture treatment varies according to certain conditions, such as the classification of the fracture. The rate of recovery after fracture in the lower extremity bones is also different from each other.

The most common lower extremity fractures, which usually occur during high-speed traumas, are fractures of the femur, which is one of the longest and strongest bones in the body and is one of the bones that carry the load of the lower extremity. [3,4] Approximately 7% of all femur fractures are distal femur fractures. [4]Another lower extremity fracture is tibial fractures. Tibial fractures mainly affect young adults. These fractures are usually accompanied by soft tissue lesions that will affect their treatment. [5]Another fracture is tarsal bone fractures. Approximately 60% of all tarsal bone fractures are the calcaneal bone, which is the most frequently fractured tarsal bone, while navicular bone fractures are less common.[6,7]Calcaneal fractures are seen together with intra-articular fractures involving most of the subtalar joints. Since the calcaneus is positioned to absorb body weight, the load bearing and rehabilitation period is delayed in this fracture compared to other lower extremity fractures. [8] The treatment of lower extremity fractures has evolved from conservative treatment to surgical treatment. The goal of surgical treatment of these fractures is to achieve a good reduction of the joint to allow early active mobilization, thereby minimizing joint stiffness and severe muscle atrophy seen in conservative treatment.

As a surgical application, open reduction internal fixation (ORIF) method is seen as the most reliable method to provide articular surface restoration in terms of coronal, axial and sagittal plane alignment. [4] However, conservative treatment can also be used in some lower extremity fractures such as the calcaneus, considering complications such as infection after surgical treatment or the need for a second operation to remove the screws and plates that cause pain. [9]

After lower extremity fractures, kinesiophobia may develop by deteriorating gait and balance parameters in the patient. These conditions may negatively affect the treatment and rehabilitation process and slow down the transition process of the patient to his daily life activities. The aim of this study is to evaluate the gait disturbances, balance problems and kinesiophobia that may occur after reduction of different lower extremity fractures using the ORIF method, which is seen as the most reliable surgical application in the treatment of lower extremity fractures, and to accelerate the recovery process by guiding the rehabilitation program suitable for the patient according to the evaluation results.

Individuals and Methods

This study was carried out at Ahi Evran University School of Physical Therapy and Rehabilitation, approved by the local ethics committee and was conducted in accordance with the Declaration of Helsinki. Written and verbal consent was obtained from all participants before starting the study. The study was conducted in accordance with the principles of the Declaration of Helsinki.

A total of 21 individuals, 8 women and 13 men, were included in the study. Socio-demographic and physical characteristics of all participating individuals were recorded. Inclusion criteria; The participants must have a femur, tibia or tarsal fracture and fracture fixation with ORIF method, not have any systemic disease and any lower extremity-related disease, sensory loss, diabetic and peripheral neuropathy, and not have undergone any surgical operation other than the related fracture in the lower extremity. Patients with chronic inflammation, bone metabolism diseases, any systemic dysfunction, neuromuscular, cardiovascular, pulmonary, vestibular or rheumatological disease, periodically using drugs and receiving conservative treatment were excluded from the study. All cases included in the study consisted of cases in which fracture fixation was achieved with plaster cast. When the fracture stories of the cases were examined, it was determined that 6 people were exposed to lower extremity fractures due to falling from a height, 10 people due to in-vehicle traffic accidents, and 5 people due to work accidents. Balance and walking of individuals were evaluated with tinetti balance and gait analysis, gait analysis with “Biodex Gait Trainer” system, and fear of movement with Tampa kinesiophobia scale.

Tinetti Balance and Gait Analysis

Tinetti balance and gait analysis was used to evaluate the balance and gait of individuals. Although it is not possible to evaluate all patients at risk of falling, it is an inexpensive, simple and reproducible evaluation method. It is used for the evaluation of gait or balance in balance and gait disorders due to underlying causes. [10]It is easy to apply in clinics by healthcare professionals. The Tinetti balance scale performed well in terms of inter-interpreter reliability and validity. This test evaluates balance with 14 items of 24 points, walking with 10 items of 16 points, with a total score of 40 points. The higher the score, the better the performance. [11] If the patient's total score is high but gets a low score from one of the scoring categories, this may constitute a risk factor for falling. It should be ensured that these patients have appropriate support and a safe environment at home against the risk of falling. [10]

Biodex Gait Trainer

The Biodex Gait Trainer system was used to measure gait parameters. This system includes a floor that measures gait parameters, a monitor that provides visual feedback, and speakers that provide auditory feedback. Measured parameters are stride length, stride speed, stride width, cadence and stance phase evaluation. The gait parameters measured by this device were statistically analyzed. [12]

Tampa Kinesiophobia Scale

TKS (Tampa Kinesiophobia Scale) is among the most commonly used methods in the assessment of kinesiophobia. It is reported that patients with high scores on this scale have higher pain levels and are more injured and injured. TKS consists of 17 questions in total for the quantitative evaluation of kinesiophobia by Miller et al. A score of >37 in the test is defined as an indicator of a high level of kinesiophobia in patients. [13]

Treatment Program

Following appropriate surgical fixation, there are fracture- and patient-specific conditions that must be considered when determining appropriate rehabilitation protocols. Fracture-related conditions include the location of the fracture and whether there is a weight-bearing bone of the lower extremity. Similarly, evaluation of proximity to the joint and intra-articular involvement is also very important, as more restraint may be required to allow immediate full weight-bearing in periarticular fractures. In patients with lower extremity fractures, the use of crutches or walkers may be required for mobility, and therefore the upper extremities should be weighted. The percentage of body weight placed on the upper extremity was 25% with a cane, 45% with a single forearm crutch, and 80% with a crutch. The upper extremities can also be strengthened in the treatment in order to provide these weights on the upper extremity in a more controlled manner. [14]

The literature suggests that immediate weight bearing after surgical fixation of femoral shaft fractures is safe and effective despite the presence of fracture fragmentation. Distal femoral periarticular fractures are treated with protected weight bearing for 6-12 weeks postoperatively. In the treatment of tibial plateau fractures, weight-bearing limitation is preferred for up to 6-12 weeks postoperatively, and range of motion exercises are allowed immediately after surgery to prevent joint stiffness, regardless of the fracture pattern and complexity of the fixation strategy. Immediate weight bearing following the surgical treatment of intra-articular calcaneal fractures, which is another fracture, is also not a recommended protocol. The literature supports 4-6 weeks of weight-bearing followed by progressive weight-bearing as tolerated in this fracture. In summary, in the treatment of general lower extremity fractures, the fracture type and the stability of the fixation structure and the patient's condition play a role in deciding the treatment, and the treatment is shaped according to these conditions. [14]

Statistical analysis

For statistical analysis, 20 statistical package programs of SPSS (Statistical Package for Social Sciences) were used. Descriptive statistics were presented as mean ± standard deviation and percentage. In this study, one-way ANOVA was used to detect the statistical difference between the groups. Statistical significance value was accepted as $p<0.05$.

Results

Eight of the 21 cases included in the study were femur fractures, 6 were tibia fractures, and 7 were tarsal bone fractures. The mean age of the subjects included in the study was 44.53±8.12 years, and the body mass index was calculated as 27.40±3.89 kg/m2. When the age and BMI values of the individuals were compared, no significant difference was found between the groups. The mean age of the cases, BMI values and the scores they got from the measurements are shown in Table 1.

Table 1. Scores of the subjects from the measurements made.

Variable	Femur Fracture (n=8)	Tibia Fracture (n=6)	Tarsal Fracture (n=7)	p*
Age	43,15±8,56	45,37±7,98	44,56±6,15	0,097
VKİ	26,45±3,01	28,16±3,81	27,12±4,32	0,124
TKS	43,18±3,12	49,24±2,78	46,84±1,64	**0,021**
Stride length (m)	0,65±0,01	0,64±0,01	0,61±0,03	0,080
Step speed (m/s)	0,68±0,14	0,65±0,19	0,64±0,15	0,119
Step width (m)	0,15±0,02	0,14±0,03	0,16±0,04	0,151
Cadence (adım/dk)	99,21±11,24	100,45±10,37	95,37±9,61	0,051
Stance phase (%)	61,12±2,03	62,02±5,12	49,04±1,05	**<0,001**
Tinetti balance and walking test	24,34±0,98	25,14±1,21	20,04±1,34	**0,037**

*p: One-way ANOVA, BMI: Body-mass index, TKS: Tampa Kinesiophobia scale

Discussion

Lower extremity fractures are associated with significant long-term functional impairment. Patients with these injuries show lower and slower recovery rates due to chronic pain and permanent disability. [15] When the literature is examined in detail, it is seen that different complications occur after lower extremity fractures. Considering these results, patients with lower extremity fractures are likely to develop gait disturbances, loss of balance, and fear of movement. When we look at the most important results of our study by evaluating these possibilities, it is seen that the kinesiophobia of the lower extremity femoral fracture group, the stance phase score and tinetti balance walking test score of the tarsal fracture group are significantly worse than the other groups. Accordingly, functional scores may vary as a result of fractures in different regions and different bones of the lower extremity. These results may also be effective reasons for the decrease in the recovery rate.

In a study in the literature, TKS scores used to evaluate kinesiophobia in individuals with a history of fracture were found to be significantly higher than in patients without fractures, but no significant difference was found between TKS scores in terms of fracture site. In our study, the kinesiophobia value was found to be significantly higher in patients with femoral fractures compared to other patients. [16] In another study, no significant limitation differences were found in normal joint range of motion values after lower extremity fractures. Pain-related immobilization of the entire extremity after lower extremity fractures may be the cause of insignificant impairment in normal range of motion. Previous studies have reported that pelvis and acetabular fractures in the lower extremity are less problematic in terms of movement, unlike knee fractures. The authors hypothesized that open fractures and associated complications, which are common after knee injuries, are mainly responsible for poor outcomes and delayed rehabilitation. [15] Gait analysis is used to assist in the diagnosis and treatment of gait abnormalities that occur after a fracture. Suciu et al. In a study by T.R., 30 patients with bimalleolar fractures who underwent surgery and rehabilitation and 21 healthy individuals were compared using gait analysis for stride time, stride length, stance time, sway time, load response time, pre-swing time, single support time, cadence and speed variables. All gait variables were decreased in both the affected and unaffected ankles of the patient group. [17] One of the most significant changes in the comparison of previously injured extremity with non-injured extremity shows that patients still reduce the amount of weight transferred to their previously injured extremities, despite long follow-up periods. With the reduction of stance time and maximum load, less weight is placed on the fractured extremity in a shorter time. Jansen et al. showed that the overall pressure on the bottom of the foot is also reduced in calcaneal fractures. [18] Another study revealed that lower walking speed and muscle strength in individuals with fracture exposure were more strongly associated with an increased risk of death in the first year after fracture compared to the non-fracture condition. [19] In another study, no significant difference was observed in the Tinetti score of patients who underwent surgery after knee fracture. In our study, while a significant difference was observed in tarsal bone fractures in Tinnetti score, no significant difference was observed in femur and tibia fractures. [20]

According to these results and the results of our study, efforts should be made to increase the decreasing stance phase with weight transfers in the rehabilitation program after lower extremity fractures. Appropriate exercises should be given to patients who develop kinesiophobia and it should be aimed to correct other impaired functions. With the appropriate rehabilitation program, the patients can transfer weight in a balanced way on both legs, and the gait and balance function can be restored. In this way, the patient will be as independent as possible in his daily life. As a result, balanced weight bearing of both legs is the basic requirement in normal walking. In the first days after the surgery, gait analysis is performed and if a decrease in weight bearing is detected, the pain regimen and physical therapy program should be adjusted accordingly. Considering these conditions, which parameter of walking in different bones showed more change in which bone fracture after lower extremity fractures, we reached the answers to these questions. Considering the results of our study and the results of other studies, treatments aimed at changing the low walking speed and muscle strength, which increase the risk of mortality, can be applied in treatment programs to reduce morbidity and mortality rates.

Conflict of Interest

The authors declare no conflict of interest.

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