

Research Article

## Why Patients after Fractures of the Distal Part of their Lower Limb ask for in-Hospital Rehabilitation?

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### Abstract

#### Background

Generally, patients with fractures of the tibia, ankle or heel, operated or not, are discharged to home directly from the Orthopedics Department, even when non-weight bearing on the involved limb is recommended. Later on, they can receive rehabilitation treatment in the community. Rarely, with the same kind of injuries, asked to receive in-hospital rehabilitation few days after casting or operation.

#### Aim

To investigate why relatively young people insist to receive in-hospital rehabilitation following fractures in the distal part of the leg (DPL) bones, instead of going home and have physical therapy in the community.

#### Design

Pre-intervention study for decision making.

#### Setting

Rehabilitation and orthopedics departments in the Galilee Medical Center.

#### Population

Twenty study group patients called "participants" and twenty-four control group patients were recruited for this study.

#### Methods

All the forty-four patients were hospitalized in the Department of Orthopedics after an accident that caused either tibial and fibular fracture, isolated ankle fracture, or heel fracture. Only the participants were hospitalized for rehabilitation treatment

before being discharged to home, according their request. Their personal data, information about the actual injury, their medical history, and familial situation, were collected, in order to see if they have any influence about their decision making.

## Results

Study group mean age was  $55.35 \pm 11.4$ , and control group mean age was  $46.6 \pm 16$  (Independent T-test,  $p=0.047$ ). Of the 20 study group participants, 70% suffered from either chronic neurological or mental disease, blindness or disorders in one or more limbs, in contrast to 4% in the control group (Fisher Exact Test,  $p<0.001$ ). The injured leg in all 24 control group patients was plastered with a circular cast, compared to only 6 study group patients (Fisher Exact Test,  $p<0.001$ ).

## Conclusions

Older age, existence of severe chronic disease or acute lesion in another limb, or when the injured leg is free of circular cast which allows an immediate physical therapy program, can justify in-hospital rehabilitation short time after injury.

**Keywords:** Tibia; Ankle; Heel; Fracture; In-Hospital Rehabilitation

The goal of rehabilitation after distal part of the leg (DPL) fractures is to decrease pain, restore full function to the ankle joint, and regain patient's mobility. Rehabilitation emphasizes restoring full range of motion, strength, proprioception, and endurance of all adjacent joints while maintaining independence in all activities of daily living, if not contraindicated by the stability of the fracture. Gait training using appropriate assistive devices is indicated to promote independent ambulation. The individual may progress from walker to crutches and then to a cane, based on the ability and weight bearing status. After cast removal, range of motion, proprioceptive activities, and strengthening exercises of the involved limb should be started [1].

Tibial fractures are associated with high incidence of delayed union and non-union [2-5]. Although weight-bearing is done mostly through the tibial bone, fracture of the tibia is often associated with fracture of the fibula because force is transmitted via the inter-osseous membrane that connects the two bones [6]. For uncomplicated fractures, closed reduction and a cast may be the only treatment required. Compound or displaced fractures may require external fixation device or surgery for open reduction and internal fixation with pins, plates, screws, or intra-medullary rods placed longitudinally within the shaft of the bone [1,7-9].

Ankles fracture, treated either surgically or non-surgically, is followed by immobilization period to prevent complications

such as mal-union. For normal daily activities, 10 degrees of ankle dorsiflexion is essential. Plantar-flexion follows dorsal-flexion and exceeds it by an average of 5 degrees [10]. Stevens, Stevens et al [11] assessed the relative contributions of voluntary muscle activation failure and muscle atrophy to loss of plantarflexor muscle torque, in 9 patients with unilateral malleolar fractures treated by open reduction-internal fixation and 7 weeks of cast immobilization. Subjects participated in 10 weeks of rehabilitation that focused on both strength and endurance of the plantarflexors. Both increases in voluntary muscle activation and muscle hypertrophy contributed to the recovery of muscle strength following immobilization, with large gains in activation during the first 5 weeks of rehabilitation.

Calcaneal fractures are mostly the result of a traumatic incident and high impact situation. Most fractures are due to falls from a height and occur in isolation [12]. For the majority of patients, surgery is the correct form of treatment. After the surgery, active range of motion exercises may be practiced with small amounts of movement for all joints of the foot and ankle, and the patient will progress to gradual weight bearing [13].

Bone healing may occur within 6 to 16 weeks. However, return of full bone strength and the ability of the bone to sustain a heavy load may take up to a year [2]. It is important to instruct the individual not to overload the fracture site until the bone has regained its full strength. Once healing has occurred, the individual may resume activities of daily living.

Physical therapy begins once the brace or cast is removed. Prior to this, simple toe-wiggling is the only exercise. If the patient has undergone surgical treatment to fixate the lower leg fracture, then rehabilitation begins as soon as the surgeon recommends it, sometimes before partial or full weight bearing is allowed. Each surgeon sets specific restrictions based on the type of fracture, surgical procedure used, personal experience, and how fracture healing is progressing. Once the cast or brace is removed, treatment will focus on regaining range of motion and strength in the ankle, foot, and entire lower limb.

Rehabilitation after DPL fractures can begin soon after the fracture has been treated, either surgically or non-surgically, by the use of different types of immobilization that allow early commencement of exercise. Alternatively, rehabilitation, including the use of physical and manual therapies, may start following the period of immobilization [14].

In our hospital, patients with fractures in the DPL are discharged home at the end of the orthopedic therapy, either conservative or surgical, and receive the rehabilitation treatment in the community, especially since non-weight bearing on the involved limb is recommended for more than one month after injury. Also the mutual services that pay for the rehabilitation

prefer to give the treatment out of the hospital due to lower costs. Our purpose was to investigate what reasons lie behind the requests of relatively young people with fracture of the DPL, to rehabilitate as inpatients, although they have access to all necessary facilities on an outpatient basis or at homecare.

### Patients and methods

From 2009 to 2014, a cohort of 20 patients, 12 women (60%) and 8 men (40%) were recruited for this study (the "participants"). All were hospitalized in the Galilee Medical Center Department of Rehabilitation following an accident that caused either isolated ankle fracture, tibial and fibular fracture or heel fracture. Previously, they were treated in the Department of Orthopedic Surgery and expressed the desire to undergo rehabilitation treatment before discharge from the hospital. They were all included in the study. All the participants were interviewed by a physician regarding the circumstances of their accident, previous injuries to their limbs, the existence of co-morbidities that could explain their need for in-hospital rehabilitation, their employment status at the time of injury, and whether they live alone or with a partner (table 1). Other personal details, information about medical or surgical treatment post-injury and permission to bear weight on the involved limb were collected from their medical records during their rehabilitation period.

The control group included 24 patients, 13 women (54%) and 11 men (46%) hospitalized in the Galilee Medical Center Department of Orthopedic Surgery during 10 months in the year 2012 following ankle or heel fracture and were discharged directly for homecare. They were collected randomly, excluding very young (<18) or very old age people (>75), or patients who were discharged for nursing home. All the information was collected from the medical records by a physician from the Department of Orthopedics: personal details, the circumstances of their accident, previous injuries to limbs, other co-morbidities, home-life status, medical or surgical treatment following the injury and permission/non-permission to bear weight on the involved limb (table 2). The patients of the control group were not interviewed by the physician about their decision to accept a homecare physical therapy, generally few days after surgery.

### Statistical Analysis

Statistical analysis as carried out using SPSS statistical package (Version 19). P-values of 0.05 were considered to be significantly different.

We reported continuous variables as mean and standard deviation. Categorical variables were summarized as frequency and percentage.

Patient no.	Age	Sex	Fracture	Other disease or injury	Cast	Familial situation
1	63	Female	Bimaleolar	None	Posterior splint	Divorced
2	41	Male	Bimaleolar	None	No	Married
3	41	Female	Bimaleolar	None	Walking brace	Married
4	49	Female	Bimaleolar	None	No	Divorced
5	58	Male	Tibia+fibula	Mental disease and depression	No	Separated
6	38	Female	Trimaleolar	Schizophrenia and morbid obesity	Posterior splint	Bachelor

7	68	Male	Heel	None	No	Married
8	52	Male	Tibia+fibula+ankle	Schizophrenia	Yes	Divorced
9	73	Female	Bimaleolar	None	Yes	widow
10	55	Female	Bimaleolar	Epilepsy and suicide attempts	Yes	Bachelor
11	56	Female	Trimaleolar	Spinocerebellar ataxia type 8	Posterior splint	Married
12	47	Male	Posterior malleolous+fibula	None	Yes	Married
13	55	Female	Trimalolar+fibula	Chronic osteoarthritis	Yes	Married
14	48	Male	Trimaleolar	Blindness and lymphoma	Posterior splint	Married
15	74	Female	Bimaleolar	Depression	Yes	Widow
16	55	Female	Tibia+fibula	None	Walking brace	Married
17	37	Male	Comminuted with dislocation in ankle	None	No	Married
18	62	Female	Tibia	Poliomyelitis	No	Divorced
19	67	Female	Tibia	Shoulder dislocation	No	Widow

**Table 1.** Details about the participants (n=20).

Independent t-tests and the non-parametric test Mann-Whitney or Fisher exact test were used to assess differences and to compare frequency in demographics, medical history, previous injuries to limbs, current injury and the length of stay in the Department of Orthopedics following injury between study and control groups respectively.

Patient no.	Age	Sex	Fracture	Other disease or injury	Cast	Familial situation
1	38	Male	Trimalleolar	None	Yes	Married
2	30	Male	Heel	None	Yes	Bachelor
3	19	Male	Trimalleolar	None	Yes	Bachelor
4	26	Female	Bimalleolar	None	Yes	Married
5	70	Female	Trimalleolar	None	Yes	Married
6	70	Female	Trimalleolar	None	Yes	Married
7	38	Female	Bimalleolar	None	Yes	Divorced
8	62	Female	Trimalleolar	None	Yes	Married
9	60	Female	Trimalleolar	None	Yes	Married
10	61	Female	Bimalleolar	Mental retardation+shoulder dislocation	Yes	Bachelor
11	43	Female	Bimalleolar	None	Yes	Married
12	43	Female	Trimalleolar	None	Yes	Divorced
13	62	Male	Bimalleolar	None	Yes	Married
14	47	Male	Bimalleolar	None	Yes	Married
15	62	Male	Bimalleolar	None	Yes	Married
16	43	Female	Bimalleolar	None	Yes	Married
17	58	Female	Trimalleolar	None	Yes	Married
18	18	Male	Bimalleolar	None	Yes	Bachelor
19	49	Female	Trimalleolar	None	Yes	Married

20	42	Female	External malleolous	None	Yes	Married
21	60	Male	Bimalleolar	None	Yes	Married
22	45	Male	Trimalleolar	None	Yes	Bachelor
23	55	Male	Trimalleolar	None	Yes	Divorced
24	18	Male	Bimalleolar	None	Yes	Bachelor

**Table 2.** Details about the control group (n=24).

## Results

The mean age of the participants (n=20) was 55.35±11.4 (range 37 - 74) and the mean age of the control group (n=24) was 46.6±16 (range 18 - 70); the age of the patients rehabilitating in-hospital was significantly higher than the age of those discharged to home from the Department of Orthopedics (Independent T-test,  $p=0.047$ ). Only 10 from the 20 participants (50%) and 15 from the 24 in the control group (62.5%), were married.

Among the participants, seven patients had bimalleolar fracture, four had trimalleolar fracture, two had isolated tibial fracture, one had heel fracture, one had open comminuted fracture-dislocation at the ankle, and five had mixed fractures at different levels of the tibia and fibula. One patient also had an additional fracture of the fifth metatarsal bone of the opposite leg. The right leg was fractured in 12 patients, the left leg in 8 patients.

Seven patients fell from a standing position, four fell from a higher level, three fell on the stairs, another three were injured in road accidents, one patient jumped from height in a suicide attempt, one was injured while sledding, and one was a victim of violence.

In fifteen patients weight bearing on the involved leg was forbidden, in four it was permitted, and one patient received the authorization for partial weight-bearing.

Ten patients were employed and ten unemployed at the time of injury.

In the control group, eleven patients had bimalleolar fracture, eleven had trimalleolar fracture, one had a fracture in the

external malleolous and another had a heel fracture. The right leg was fractured in 14 patients and the left leg 10 patients. Sixteen patients fell from standing position, three from height, two on stairs, two from bicycles, and one was injured in a road accident. Weight bearing on the involved leg was forbidden in all 24 patients. Information about their history was collected from their medical record in the Department of Orthopedics after discharge.

Of the 20 participants, 70% (n=14) suffered from either chronic neurological or mental disease, blindness or from disorders in one or more limbs (table 1), as opposed to 4% (n=1) in the control group (Fisher Exact Test,  $p<0.001$ ).

The injured leg in all 24 control-group patients was plastered with a circular cast, in contrast to only 6 "participant" patients (30%) (Fisher Exact Test,  $p<0.001$ ). Among the other 14 "participants", 8 underwent surgery, but all of them had either removable cast or orthosis in the involved leg.

The median length of stay in the Department of Orthopedics following injury was 5 days in the participants group, hospitalized later for rehabilitation, and only 3 days in the control group (Mann-Whitney Test,  $p=0.028$ ).

## Discussion

The injured leg in all 24 control group patients was casted compared to only 6 participants of 20, allowing the patients free of circular cast to do active and passive range-of-motion exercises in a rehabilitation setting. This could explain the desire of 14 participants to begin a rehabilitation program immediately after the acute phase of injury. According to Lehtonen et al [15] the long-term functional outcome after surgical treatment of an ankle fracture with a cast or after use of functional brace, are similar and do not justify the

hospitalization for rehabilitation.

To sustain early rehabilitation after DPL, Stevens et al [11,16] retained that both dorsiflexor and plantarflexor muscles which atrophied during the immobilization period after ankle fracture, hypertrophied within the first 5 weeks of rehabilitation. There is some evidence that using a removable brace or splint, gentle ankle exercises can be performed during the immobilization period and may enhance the return to normal activities, reduce pain and improve ankle movements [14].

Lin et al [17] retained that after surgical fixation, commencing exercise in a removable brace or splint significantly improve activity limitation, but also led to a higher rate of adverse events.

There is little evidence for rehabilitation interventions during the immobilization period after conservative orthopedic management and no evidence for stretching, manual therapy or exercise compared to usual care following the immobilization period [14]. Conversely, there is always some risk for complications such as disturbed wound healing, thrombophlebitis [15,18], and non-union of the fractured bone, that can motivate the patient to request in-hospital rehabilitation [2-4,18].

It is difficult to justify accommodating previously healthy patients who fractured the DPL and ask to be transferred to a rehabilitation department after the urgent orthopedic treatment, especially when the ankle joint is plastered or fixated and weight-bearing is forbidden. Transfers as well as gait training on the sound leg with the use of crutches can be done by a physiotherapist in-hospital several days after injury or surgery, and be completed at home after discharge. The older age of the participants in contrast to the control group does not explain their insistence to be hospitalized, as most of them were below geriatric age.

The existence of neurological or psychiatric disorders, as well as orthopedic injuries among the participants, could justify agreement to a short period of two or more weeks in an in-patient rehabilitation setting. Four patients suffered from psychiatric disorders, three from neurological disease, two patients from fresh fracture in an upper limb, one from chronic polyarthritis, and another one from blindness. These facts could also explain their longer period of recovery in the Department of Orthopedics, compared to the patients of the control group, among whom we found only one patient who suffering from a mental retardation disorder.

In our research, only 10 of the 20 participants (50%) were employed while the injury occurred. The desire to return to work as soon as possible may motivate them to take part in early rehabilitation program with all the facilities that exist in the hospital. Vallier et al [19] found that 95% of patients

operated using a plate or a nail after distal tibia shaft fracture, and who were employed at the time of injury, had returned to work, although 31% had modified their work duties because of their injury. Mild ankle or knee pain was reported frequently after plate or nail fixation, but did not limit activity in most. No patients reported unemployment because of their tibia fracture, but unemployed people described knee and ankle pain more frequently and had the worst functional outcome scores. Improving patient compliance with attendance for rehabilitation may improve employment outcome [20].

## Conclusion

We found that the main reasons that justify the request of relatively young people with fractures in the DPL to receive rehabilitation treatment in hospital are: 1. the existence of chronic disease, mental or nervous-system disease, or acute injury in one of the other limbs. 2. If the injured leg is free of long-term circular cast, a physical therapy program may begin few days after the orthopedic treatment is finished. 3. A relative older age of the patients.

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