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# THE ROLE OF PHYSIOTHERAPY IN THE RECOVERY OF THE SURGERY OF THE BIMALLEOLAR FRACTURE

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***Abstract:*** *Malleolar fractures are one of the most common types of fractures, ranking second after hip fractures, wrist fractures, and hand fractures. Also, malleolar fractures are the second most common fracture requiring hospitalization. By using physiotherapy methods and complementary means of recovery over a period of 6 months, the mobility of the ankle joint will be improved as well as the resumption of socio-professional activity by the patient. The essence of the research in this article is based on demonstrating the importance of using physical therapy tools to achieve the proposed objectives. At the same time, it will provide the patient with the opportunity for reintegration both professionally and socially.*

***Key words:*** *kinetic means, recovery, malleolar fracture.*

## 1. Introduction

The ankle joint (or talocrural joint) is a synovial joint located in the lower limb.

It is formed by: the shin bones, tibia and fibula, and the talus bone.

Functionally, it is a "hinge" joint, which allows plantar flexion and dorsiflexion of the foot [11].

At the distal epiphysis of the tibia, there is the medial malleolus, visible and palpable under the skin, with the help of which the articulation with the talus is achieved.

The lower epiphysis of the fibula is formed by a prominence called the lateral malleolus, which is palpable under the skin. This presents an articular surface for the tibia and talus [3].

The tibia and fibula are connected to each other by the anterior tibiofibular and posterior tibiofibular ligaments. Together they form a bracket-shaped cavity covered in hyaline cartilage, a joint known as the syndesmosis, into which the talus inserts [11].

Bones are made up of: bone substance, bone marrow, periosteum, vessels, and nerves [3].

The supply of nutrients to the ankle is provided by the malleolar branches of the anterior tibial, posterior tibial and fibular arteries.

Innervation is provided by the tibial, superficial and deep fibular nerves [11].

The epiphyses of the tibia and fibula are

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made of spongy substance, formed by bone trabeculae positioned in different directions. The trabeculae cross at certain points, thus delimiting the bone marrow cavities.

Most movements of the ankle joint are made possible by twelve muscles that originate in the calf and insert into the foot. These muscles are divided into four compartments.

The anterior compartment is made up of the tibialis anterior, extensor digitorum longus, extensor hallucis longus, and peroneus tertius muscles.

The lateral compartment is composed of the peroneus longus and peroneus brevis muscles.

The posterior compartment is composed of three muscles: the gastrocnemius, soleus, and plantaris.

The deep posterior compartment is composed of the tibialis posterior, flexor digitorum longus, and flexor hallucis longus muscles [2].

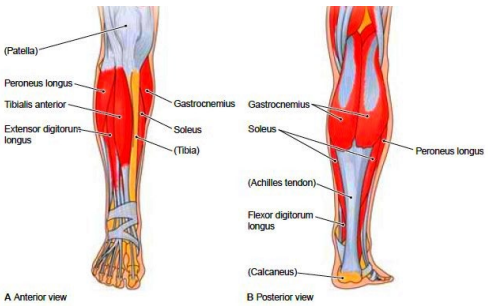


Fig. 1. *Muscles of the anterior/posterior compartment,* [15]

### 1.1. Elements of biomechanics

Plantar flexion – the posterior movement of the foot in the sagittal plane and frontal axis.

The amplitude of the movement is between 0° and 40°- 45°.

The movement is performed by the muscles: gastrocnemius, soleus, plantar, tibialis posterior, flexor digitorum longus, flexor hallucis longus, peroneus longus and peroneus brevis.

Dorsiflexion – anterior movement of the foot in the sagittal plane and frontal axis.

The amplitude of the movement is between 0°-20°.

Movement performed by the muscles: tibialis anterior, extensor digitorum longus, extensor hallucis longus and peroneus tertius [5].

**a) Forces in the ankle joint and mechanisms of ankle joint fractures**

The ankle has a high level of congruence, meaning that despite experiencing high loads during normal activities, the ankle's load-bearing area is large (11-13 $cm^2$) and it has been proposed that this should result in less stress than at the hip or knee.

The ankle joint supports a force of approximately five times body weight during walking and up to thirteen times body weight during activities such as running [2].

Fractures are a complete or partial break in the continuity of a bone.

Fractures occur when the bone surface gives way due to the force applied to it.

The ankle joint must be flexible to cope with the enormous forces exerted on the talus.

There are two positions of the foot in which the ankle joint becomes a rigid and vulnerable system: extreme supination and pronation.

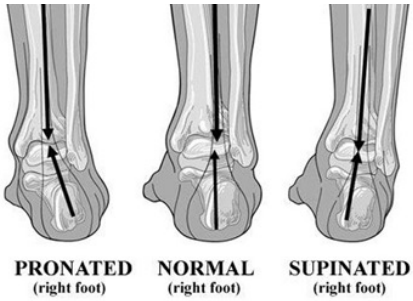


Fig. 2. *Pronation and supination* [14]

In these positions, the forces applied to the talus in the ankle joint can result in fractures of the malleolus and ligament tears.

Ankle fractures are usually the result of a sustained twisting mechanism following a low-energy injury.

In bimalleolar fractures, both the medial and lateral malleolar are affected.

According to the classification made by Lauge Hansen, injuries occurring during supination and external rotation movements are the most common causes of bimalleolar fractures.

Eversion movement is the most common cause of bimalleolar fractures [8].

**b) Physical therapy tools**

Occupational therapy – is a complex method of recovering from physical or mental conditions using work or other occupation to correct or compensate for various functional deficiencies.

Occupational therapy can have a stimulating effect on an ankle with post-traumatic sequelae, contributing to the reeducation of gait [12].

The effects of occupational therapy aim to improve movement skills through a treatment with analytical and global movements, aiming to maintain the function of all muscle groups and good joint function [4].

Hydrokinetotherapy – is a set of exercises performed with the body immersed, with the aim of re-educating certain deficiencies, benefiting from the mechanical, chemical and physical factors, especially the thermal ones, of water [4].

The advantages of hydrokinetotherapy are:

• weight relief of the body;
• heat of the water;
• use of the hydrostatic force of pushing the body from the bottom up;
• use of water turbulence for resistance exercises;
• re-educating gait;
• therapeutic swimming [9].

Kinesio taping therapy – consists of applying elastic bandages to key areas of the body at the level of muscle, joint or ligament injuries. It directly stimulates the peripheral circulatory and lymphatic systems, and indirectly, the muscular and nervous systems [16].

Kinesiology tapes are frequently used for the following purposes:

• Facilitation: Kinesiology tapes can be used to improve muscle contraction thus determining a normal muscle tone.
• Inhibitory purpose and pain management.
• Support and stability: provides stability without limiting movement.
• Edema management.
• Scar tissue management after surgery or trauma [16].

Trigger point therapy – Trigger points, also known as “trigger points”, are small points that appear on muscles when they are overworked or injured.

The purpose of acupressure is to relieve muscle pain and treat certain conditions by applying pressure to contracture points.

Trigger points are defined by punctiform

hypersensitivity in skeletal muscles. They are associated with palpable nodules, which when pressure is applied can cause sharp or dull pain, stiffness, a feeling of heat or cold, and can even cause nausea, loss of balance, and visual disturbances.

The major objectives of the therapy are:

• elimination of protective muscle tension;

• elimination of peripheral receptor hypersensitivity;

• obtaining local vasodilation with immediate tissue oxygenation effect;

• elimination of local ischemia;

Therapeutic benefits:

• relaxation of muscle tissues;

• improvement of joint mobility and muscle elasticity;

• pain relief through the release of endorphins;

• relief of depression and anxiety;

• reduces fatigue and improves sleep quality;

• postural reeducation;

• improvement of the body's recovery process [9].

TECAR therapy – the term "TECAR" is an acronym for "Capacitive and Resistive Energy Transfer" [17]

TECAR therapy is a form of combined contact diathermy and electrotherapy. It is a medical practice that applies electromagnetic energy to biological tissue.

The applied electromagnetic frequency comes from the radiofrequency spectrum. Unlike electrotherapy, it does not cause muscle contraction. The therapeutic wave spectrum ranges from 300KHz to 1.2MHz [17] .

Effects of TECAR therapy:

• reduces pain;

• improves superficial and deep blood circulation;

• improves tissue regeneration;

• stimulates venous and lymphatic drainage;

• affects the restoration of metabolic balance activity [17].

Ultrasound therapy – consists of the application of sound vibrations that exceed the threshold of auditory excitability for therapeutic purposes. Therapeutic sound waves can have a frequency between 500-800KHz [5].

Effects of ultrasound:

• Vasodilator;

• Analgesic;

• Decontracturant;

• Central effect;

• Fibrinolytic effect;

• Decreased muscle spasm;

• Increases the elasticity of sclerotic tissues;

•Biotrophic: supported by the anti-inflammatory resorptive effect.

Laser therapy – consists of amplifying light through stimulated emission of radiation. Laser light is of a single color, the wavelength is perfectly straight and the lights are absolutely equal to each other in time and space [5].

Effects of laser therapy:

• anti-inflammatory effect;

• reduction of acute or chronic pain;

• strengthening the immune system through non-specific biostimulation;

• increase in protein synthesis;

• reduction of edema;

• stimulation of vascularization and wound healing;

• activation of the neuroendocrine system;

• increase in ATP and phosphorylation.

Balneotherapy – is the practice of immersing a subject in mineral-rich water or mineral-laden mud [18].

The main categories of baths with a

therapeutic effect are:
• Medicinal baths in which drugs or other substances with a curative role are introduced.
• Thermal baths use thermal spring waters at the temperature of the surface outlet.

## 2. Material and Methods

### 2.1. Date, place and subjects of the research

The research was conducted on 29.10.2020 at the Rafael Brașov Center.

The research subject is a female, aged 40, diagnosed with a bimalleolar fracture in the left lower limb.

The following materials were used during the recovery: elastic bands of different resistances, bosu ball, balance board, mechanical stepper, foam ball, trellis, ergometric bicycle, Tecar Winback combine.

### 2.2. Evaluation methods

a) Somatoscopic examination - In the sagittal plane, the ankle joint presents edema and ecchymosis.
b) Joint assessment - Following the joint assessment, it was found that the patient suffers from total functional impotence.

### 2.3. Research procedure

The objectives of the recovery program:
1. Reduce pain;
2. Increase joint mobility;
3. Increase muscle strength.

*Period, methods and techniques used and specific objectives* Table 1

| Recovery period | Methods and techniques used in recovery | Objection |
|---|---|---|
| Week 1-2 | Passive mobilizations<br>Massage<br>Physiotherapy - TECAR<br>Kinesiotaping | Increased joint mobility<br>Relaxation of the healthy limb<br>Reduced pain<br>Reduced bruising |
| Week 3-4 | Active and passive mobilizations<br>Isometric exercises<br>Massage<br>Physiotherapy - TECAR<br>Kinesiotaping | Increased joint mobility<br>Increased muscle strength<br>Relaxation of the healthy limb<br>Reduced pain<br>Reduced bruising |
| Week 5-6 | Active – passive mobilizations<br>Isometric exercises<br>Massage | Increased joint mobility<br>Increased muscle strength<br>Relaxation of the healthy limb |
| Week 7-8 | Active-passive mobilizations<br>Active mobilizations with resistance<br>Isometric exercises<br>Massage | Increased joint mobility<br>Increased muscle strength<br>Relaxation of the healthy limb |
| Week 9-10 | Active mobilizations<br>Active-passive mobilizations<br>Active mobilizations with resistance<br>Isometric exercises<br>Massage | Increased joint mobility<br>Increased muscle strength<br>Relaxation of lower limb muscles |

| Recovery period | Methods and techniques used in recovery | Objection |
|---|---|---|
| Week 11-26 | Active mobilizations<br>Activo-passive mobilizations<br>Active mobilizations with resistance<br>Isometric exercises<br>Balance exercises<br>Massage<br>Kinesiotaping<br>Physiotherapy - TECAR | Increased joint mobility<br>Increased muscle strength<br>Increased balance<br>Relaxation of lower limb muscles |
| Week 27-28 | Active mobilizations<br>Active-passive mobilizations<br>Active mobilizations with resistance<br>Isometric exercises<br>Balance exercises<br>Massage<br>Kinesiotaping<br>Myofascial therapy<br>Physiotherapy - TECAR | Increased joint mobility<br>Increased muscle strength<br>Increased balance<br>Relaxation of lower limb muscles |

## 3. Results and Discussions

The results were obtained after careful examination of the patient throughout the recovery program. The patient was given the necessary assessments to generate the objectives of the physiotherapy program but also to obtain feedback on the effectiveness of the applied program.

Over a period of 30 days, the patient performed a recovery program in a different recovery clinic, without having a positive result, complaining of pain due to joint stiffness.

The initial assessment was performed on the first day of the recovery program, and the final assessment at the end of the physiotherapy program.

Joint assessment was performed at the beginning and end of the rehabilitation program. The tests were performed actively to provide the most accurate and efficient diagnosis regarding mobility deficit.

To design the most efficient therapeutic program, the results obtained from the assessments were compared with the ideal values specific to the ankle joint.

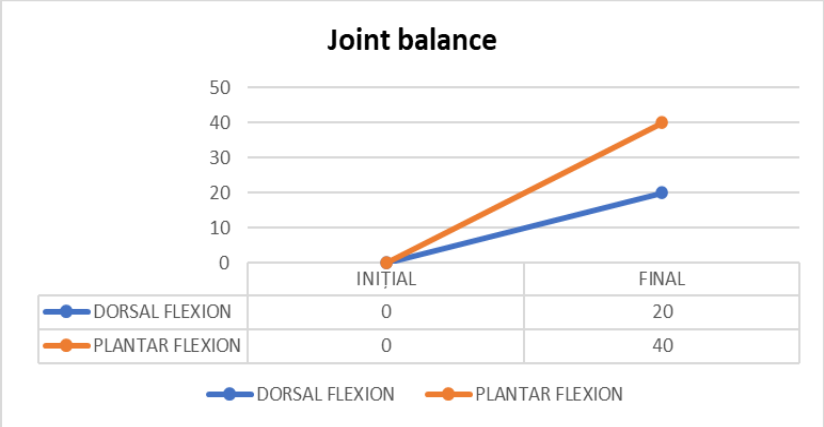


Fig. 3. *Interpretation of joint balance results – dorsal flexion and plantar flexion*

Initially the patient had total functional impotence in the ankle joint, at the end of the 6 months of recovery he was able to achieve plantarflexion at 40° and dorsiflexion at 20°.

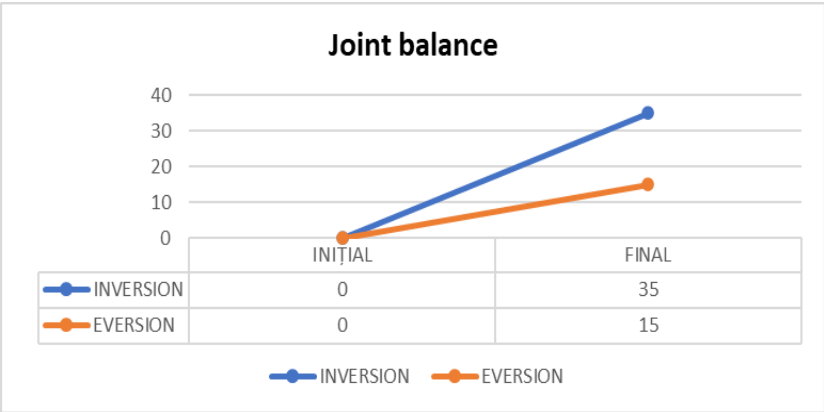


Fig. 4. *Interpretation of joint balance results – inversion and eversion*

Following the 6-month recovery program, the patient achieved 35° inversion and 15° eversion.

The discussion highlights the importance of careful and continuous patient assessment throughout the postoperative recovery program for bimalleolar fracture. According to the reports presented, initial and final assessments are essential for establishing physiotherapy goals and monitoring progress. [1,7]. In the case of a patient who initially followed a 30-day rehabilitation program in a different clinic, but without positive results, symptoms such as pain and joint stiffness highlight the need for adaptation of the treatment program and continuous reassessment.

A thorough examination on the first day of the program allowed the identification of functional limitations and specific symptoms, thus facilitating a personalized recovery plan. The feedback obtained

from the final evaluation was crucial to determine the effectiveness of the physiotherapy intervention and to adjust the program, according to the principles recommended in the specialized literature. Thus, optimal recovery after bimalleolar fracture depends not only on the application of specific exercises, but also on the permanent monitoring of the patient and the dynamic adaptation of therapeutic interventions.

These findings support the idea that a standardized physiotherapy program may not be effective for all patients, and an individualized approach is essential to prevent complications and restore the functionality of the affected joint. Thus, the integration of periodic assessments and patient feedback significantly contributes to the success of recovery and to the reduction of pain associated with joint stiffness [7].

Joint assessment was performed both at the beginning and at the end of the rehabilitation program, through active testing designed to ensure an accurate diagnosis of the mobility deficit of the ankle joint. This active approach allows for a real functional assessment of the patient, accurately identifying the degree of limitation and the aspects that require specific therapeutic intervention. The results obtained were compared with the ideal mobility values for the ankle joint, according to medical standards, to establish a clear benchmark in the recovery process.

Through this comparison, the therapeutic program could be adjusted to target the specific deficit, thus maximizing the effectiveness of the physiotherapy intervention. Continuous monitoring of joint mobility through joint balance provided relevant information about the patient's progress and the need for changes in the treatment protocol. In line with recent studies, this assessment method contributes to the personalization of recovery programs, essential in preventing complications such as joint stiffness or persistent pain [1,6,7,10].

Thus, active joint balance represents a fundamental tool in physiotherapy, facilitating not only diagnosis, but also optimizing the treatment plan, with the aim of restoring ankle mobility and functionality after bimalleolar fracture.

The kinetic program plays an essential role in the functional recovery of the patient after an operated bimalleolar fracture. Through specific and progressive exercises, the aim is to reduce pain, regain joint mobility and restore ankle stability. Early and personalized intervention contributes to the prevention of postoperative stiffness and adhesions.

Periodic evaluations allow the adaptation of the program according to the patient's progress. Effective recovery requires active collaboration between the physiotherapist and the patient, as well as compliance with progressive loading stages. Proprioception and muscle toning exercises help restore balance and normal function of the affected limb.

Studies show that patients who follow a structured kinetic program have superior functional results and a low risk of complications [6,10].

Complete recovery depends not only on the surgical intervention, but also on the quality and consistency of the recovery.

## 4. Conclusions

Considering the data obtained from the application of the physiotherapy program, we can state that by developing a

recovery program, structured on the particularities of the patient in question, he can recover to a high percentage or even completely, the patient being able to successfully return to his socio-professional activity.

Following a trauma to the musculoskeletal system, the patient suffers both physically and mentally. Interruption of activity generates stress for the patient, due to his uncertainty regarding his return to daily life.

From the point of view of recovery, the patient managed, over a period of 7 months, to recover 100%, successfully resuming his activity.

Thus, we can say that the role of physiotherapy in treating fractures is very important. Through its means, physiotherapy has the role of treating, in a high percentage or completely, the negative effects on the patient, given by the disease state. managing to reintroduce the patient into his professional and social activity.

**References**


1. Bhagwatkar, S., Phansopkar, P., Chitale, N.: *Physiotherapy Rehabilitation in Operated Case of Patellar Fracture and Medial Malleolus Fracture – A Case Report*. In: Journal of Pharmaceutical Research International, Vol 33(51), 2021, p.266-270. DOI: 10.9734/jpri/2021/v33i51A33492.
2. Brockett, C., Chapman, G.: *Biomechanics of the ankle*. In: Orthop Trauma, 30(3), 2016, p 232–238, DOI: 10.1016.
3. Cioroiu, S.: *Esențial în anatomie și biomecanică (Essential in anatomy and biomechanics)*. Brașov, Editura Universității Transilvania din Brașov, Brașov, 2006, p.19,52.
4. Cioroiu, S.: *Hidrokinetoterapia deficiențelor fizice (Hydro-kinetotherapy for physical deficiencies)*. Brașov, Editura Universității Transilvania din Brașov, 2012, p. 6, 22.
5. Cioroiu, S.: *Kinetoterapie de la teorie la practică* (Physiotherapy from theory to practice). Brașov, Editura Universtății Transilvania din Brașov, 2012, p. 26-27, 83-82.
6. Gangadhran, N., Pillai, M.G.: *Study on functional outcome of bimalleolar ankle fractures treated by open reduction and internal fixation*. In: International Journal of Research in Orthopaedics, Vol. 7(3), 2021. DOI: 10.18203/issn.2455-4510.IntJResOrthop20211604.
7. Jaiswal, M., Subramanian, A., Tank, P.: *Analysis of Functional Outcome Following Open Reduction and Internal Fixation of Closed Bimalleolar Fracture in Adults*. In: International Journal of Orthopaedics Sciences, Vol.7(3), 2021, p.386-391. DOI: 10.22271/ortho.2021.v7.i3f.2775.
8. Koujan. K., Saber, Y.A.: *Bimalleolar Ankle Fractures*. Treasure Island (FL), StatPearls Publishing, 2025, p. 20.
9. *Marcu, V., Dan, M.: Kinetoterapie/physiotherapy (Physiotherapy).* Oradea, Editura Universității din Oradea, 2006, p. 11.
10. Singh, G., Basit, A., Gupta, S.: *Functional and radiological outcome of open reduction and internal fixation in bimalleolar fractures of ankle: a prospective study.* In: nternational Journal of Research in Medical Sciences, Vol. 9(9), 2021, p. 2657.

DOI:10.18203/2320-6012.ijrms20213403.
11. ***Oliver, J.: *The Ankle Joint.* Available:https://teachmeanatomy.info/lower-limb/joints/ankle-joint/. Accessed: 02-06-2025.
12. ***Onu. I.: *FizioKinetoterapia in glezna posttraumatica.* Available at: https://www.elipetromed.ro/fiziokinetoterapie-reumatica.html. Accessed: 22-06-2025.
13. ****Terapia Trigger Points.* Available at:https://terapiepentrumiscare.ro/trigger-points/. Accessed: 12-08-2025.
14. ***Volkmar, M: *Bodywork and Movement Education.* Available at: https://www.monikavolkmar.com/2020/12/07/supination/.Accessed: 13.08.2025.
15. ***https://encyclopedia.lubopitko-bg.com/Muscles_of_the_Lower_Extremities.html. Accessed: 11.08.2025.
16. ***https://centrokinetic.ro/servicii/recuperare-medicala/proceduri-speciale/kinesio-taping. Accessed: 08.07.2025.
17. ***https://centrokinetic.ro/servicii/recuperare-medicala/fizioterapie/fizioterapie-tecar. Accessed: 10.06.2025.
18. ***https://www.sfatulmedicului.ro/dictionar-medical/balneoterapie_559. Accessed: 11.07.2025.