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CONSERVATIVE APPROACH OF BIMALEOLAR FRACTURE, CASE STUDY

Breha Alexandru Mihai
Ştefan cel Mare University of Suceava
Faculty of Medicine and Biological Sciences
alexbreha@usm.ro
Pavel Răzvan Cristian
Ştefan cel Mare University of Suceava
Faculty of Medicine and Biological Sciences
Miron Evelina Ioana
Ştefan cel Mare University of Suceava
Faculty of Medicine and Biological Sciences

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Abstract

Bimalleolar fractures are injuries that cause high instability, causing significant dysfunction in the lower body. Conservative recovery involves a period of immobilization of approximately 6 weeks, followed by an adapted exercise program according to the patient's potential. Physiotherapy exercises perform mechanical work, increase mobility and muscle strength, improve elasticity and muscle tone, being the main pillar in achieving joint functionality. Electrotherapy and ultrasound therapy are adjunctive techniques that were applied in the 3rd stage of recovery, proving their usefulness in accelerating the regenerative process. The phasing of the recovery program, the monitoring of functional progress, the adaptation of the recovery protocol, are essential treatment principles, being indispensable for the medical team. The conservative treatment applied to the young patient must be managed by a multidisciplinary team that monitors the entire recovery process in order to provide a successful medical act.

Introduction

Bimalleolar fractures are highly synergistic traumas that affect both malleoli but also a series of ligaments that stabilize the ankle, thus being labeled as unstable fractures. This type of fracture accounts for 60% of all ankle traumas, with an incidence of 187 cases per 100,000 inhabitants [1].

The ankle joint consists of 3 main bones: the tibia, the fibula and the talus, being united by a distal synovial joint, which is supported by means of union on both the medial and lateral sides. The lower extremities have bony protrusions that form

the external malleolus and the internal malleolus, where a series of ligaments with a stabilizing role are inserted [1], [2]. The ligaments are divided according to the area occupied, in the medial part predominates the deltoid ligament, and laterally stability is provided by 3 different ligaments: the calcaneofibular ligament, the anterior and posterior tibiofibular ligaments [3] .

The musculature at the tibial level is distributed into sections and produces a series of movements in different planes. In the anterior compartment is the tibialis anterior muscle which is the promoter of dorsiflexion, the triceps sural complex is on the opposite side and facilitates plantarflexion. These movements are carried out in the sagittal plane and contribute to the biomechanics of walking. Inversion and eversion are carried out in the frontal plane, being supported in particular by the peroneus longus and peroneus brevis muscles, but also by the anterior tibial muscle [4]

The diagnosis of tibial pillar fractures can be attributed with the help of X-rays, 3 examinations, being necessary, from different angles, following the integrity of the bone structures. The use of CT scanning is indicated when a posterior malleolar fracture is suspected to determine the degree of impact and severity of the trauma. Magnetic resonance scanning and ultrasonography are used to examine the integrity of soft structures that may be indirectly compromised [1], [5], [6], [7].

The treatment of these injuries depends on the type of fracture, its severity and also on the opinion of the orthopedic doctor. Surgical treatment involves fixing the fracture ends that are displaced, by means of metal plates, screws, etc. to restore congruency and restore immediate stability, but at the same time there are associated risks such as: infection, pulmonary embolism, amputation and fracture recurrence. Conservative treatment is considered if the fracture focus is minimally displaced and the fracture is stable. Recovery involves a period of several weeks of immobilization in a cast to which secondary muscle atrophy, cartilage degeneration, increased stiffness and a potential for relapse are usually attributed[8].

Recovery from bimalleolar fractures can take 6 months or even longer, and edema can be present up to a year postoperative. The role of the multidisciplinary team is essential in the management of this pathology; the doctor establishes the diagnosis and treatment guidelines and the physiotherapist aims to: increase functionality, muscle strength and weight bearing as soon as the structures are strengthened[1], [9].

Working Hypothesis:
-conservative approach to bimalleolar fracture with minimal displacement can provide functionally satisfactory results
- bimalleolar fracture treatment requires socio-professional reinsertion.

Material-method

This work represents a case study, carried out during 6 months and has started on February 9, 2024, the date when the trauma occurred, during all this time we aimed to analyze the effects of the conservative approach on the bimalleolar fracture during the entire recovery period .

During the anamnesis, it was found that the patient, aged 20, with a height of 175 cm, 62 kg, suffered a bimalleolar fracture in the right lower limb. The patient in question has a normal weight profile, with a high exercise capacity, because she performs weekly intense physical exercises at the gym.

The means of production is unknown by the patient, but the pathology started suddenly due to an instability on a wet surface causing a fall; the injured leg was in a vicious posture giving way under the weight and dynamics of the body.

Following the trauma, the patient was subjected to a radiological examination performed from the front and from the profile. The medical team presented her with the recovery methods that included: the surgical approach and fixation of the fracture focus, explaining both the benefits and the risks, but also the conservative approach, which differed, from a recovery point of view. Following the analysis and discussions, an initial conservative route was established, with the potential to return to the surgical intervention, in case the fracture does not respond positively to the applied treatment.

The recovery plan in the case of conservative treatment was graded, individualized to the patient's particularities, in accordance with the recovery protocol and was carried out both at home and in the recovery office.

In order to achieve functionality, we applied physical therapy as the main means, which consisted of physical exercises applied in stages, but also a series of auxiliary means to accelerate the regenerative process, such as: electrotherapy, ultrasound therapy and specific techniques.

Evaluation of treatment response was monitored using scales and measurements performed periodically on both the affected and the healthy limb to manage percentage functional gain. The scales used during recovery were the following: the VAS scale (Visual Analog Scale) to monitor the pain felt, the ADL scale (Activities of Daily Living) to monitor the ability to perform daily activities, the FADI scale (Foot and Ankle Disability Index) to assess leg disability and the QOL (Quality of Life) scale to record the patient's quality of life [10], [11], [12].

Initial, intermediate and final measurements were taken during recovery. The functional status was monitored by: assessing joint mobility with a goniometer, muscle tone assessed by identifying the perimeters with the help of the measuring tape and, at the same time, controlling the edema by measuring the circumferences at the malleolar level. Muscle strength was assessed with the MRC (Medical Research Council) scale by quantifying the force felt during certain movements [13].

According to the specialized literature, these fractures of great synergy, as a production mechanism, called unstable fractures, are usually indicated for surgical treatment [1].

Table 1. Recovery Plan

OPERATIONAL OBJECTIVES	OBSERVATIONS
PHASE I- Weeks 1-6 Immobilization period OBJECTIVES: -Facilitating bone consolidation; - Pain and inflammation control; - Prophylaxis of complications.	Immediately after the trauma occurred, the medical team performed a radiological scan that designated the diagnosis of bimalleolar fracture, subsequently, in week 3 the orthopedic doctor decided to re-evaluate the imaging to establish the degree of bone congruency and the appearance of the newly formed callus. In the last two weeks, it was decided to switch from the cast device to a fixed orthosis to facilitate local hygiene and maintain restraint immobilization. The indications given by the orthopedic doctor were as follows: -maintaining the cast device for the first 4 weeks and the fixed orthosis for the last 2 weeks without applying weight on to the traumatized limb; - maintaining a prone position of the lower limbs to facilitate venous circulation; -adaptation of walking with crutches throughout this period; -observing the skin and alarm signals that require prompt intervention by the medical team; -management of pain and complications by administering injectable anti-inflammatories and anticoagulants. In order to support the consolidation of the fracture, physical therapy addressed the overlying structures in order to limit physical deconditioning, prevent muscle atrophy and return the patient to the activities she previously performed as quickly as possible. In this stage, isometric exercises on the extensor muscles of the knees, without stressing the joints, isotonic exercises on the contralateral limb and techniques to facilitate movement with the help of crutches were used to increase the quality of life. At the end of this period, the patient was re-evaluated by the orthopedic doctor receiving the consent to start the recovery period and the explanations regarding the duration and the steps to follow.

PHASE II- Weeks 7-8

Joint flexibility management

OBJECTIVES:

-Decreasing pain and inflammation;

-Increasing passive and active joint suppleness on all levels;

-Increasing muscle strength:

-Re-education of walking with progressive loading;

-Prophylaxis of complications;

The indications given at this stage by the orthopedic doctor were the following:

- the period of recovery assisted by the physiotherapist, begins in order to obtain functionality;

- the applied pressure will be gradually achieved, so that in weeks 7-8 the orthosis is kept fixed, and the load on the affected lower limb will be 25% and 50% towards the end of this phase, the compensatory weight being directed onto the crutches.

-walking is done over short distances in paced sessions that allow inflammation and pain control;

Cryotherapy was applied to control pain and inflammation, with the aim of lowering the local temperature causing vasoconstriction contributing to the healing process.

The recovery plan complied with the rehabilitation protocol so that, during this period, we performed:

-flexions and active extensions of the phalanges;

-passive mobilizations of the affected ankle on all movements at talocrural level performed by the physiotherapist to contribute to the capsulo-ligamentary supplization and to the removal of intra-articular and tendinous adhesions;

- free active mobilizations at the level of the ankles in all possible movements to promote joint flexibility by stimulating osteogenesis;

-active open kinematic chain exercises targeting the upper compartments (thighs, opposite lower limb) to improve muscle strength by controlling the pressure on the affected leg;

- pressure management was managed with the help of a scale, which initially tested the maximum force on the healthy leg, later establishing 25% and 50% kilograms/force, which could be applied to the leg under rehabilitation;

- active exercises aimed at improving dorsal flexion to restore the balance between agonists and antagonists;

To favor the safe transfer of the patient, walking was still performed with orthopedic canes, and the management of motor control was under the careful direction of the physiotherapist who offered constant advice to allow weight-bearing without compromising the load-bearing joints.

PHASE III - Weeks 9-12

Optimizing gait biomechanics.

OBJECTIVES:

- Obtaining the maximum mobility of the dorsal flexion;

During this phase, we followed the improvement of the patient's gait and evolution towards autonomy in order to restore her functional substrate in order to facilitate daily activities.

An important aspect of this period was marked by the removal of the fixed orthosis, the adjustment of walking with a cane and the swinging of the leg on the support surface with 75% loading and maximum pressure towards the end of week 10.

Following constant evaluations, the medical team decided to implement therapy with physical agents to control the existing edema in order to accelerate the recovery process. Physical agent therapy continued for 10 days, consisting of

- Restoring the physiological biomechanics of walking; -Improving proprioception; - Optimizing coordination; -Increasing muscle strength	locally applied electrotherapy and ultrasound therapy. From the diversity of currents that we could apply, we agreed on the use of diadynamic short period current modulated to the sensation of vibrations to obtain the resorptive effect. Ultrasound was applied periarticularly, through direct coupling, with a power density of 0.4 W/cm2, for 6 minutes to increase the permeability of cell membranes, following the resorptive and vasculotrophic effect. Physiotherapy exercises were the basis for obtaining functionality, using the following: -exercises with opposite resistance from elastic bands at the level of ankle movements; -proprioceptive neuromuscular facilitation techniques such as: slow inversion, slow inversion with opposition and repeated contraction, applied in the form of lower level contraction schemes to balance the balance between agonists and antagonists; -exercises performed with the patients own bodywieght with equal pressure on both lower limbs; - different types of walking made in the form of a obstacle course combining elements from the school of walking to improve coordination; - running exercises performed on the spot combined with various coordination tasks; -exercises for the entire lower kinematic chain aimed at the uniform development of muscle strength and tone such as: lunges, squats, lifts on the tips and heels; Towards the end of this phase, passive and self-passive static stretching was adopted at the level of the sural triceps and the hamstring complex, which involved reaching and overcoming the braking point, maintaining the final position for 6-12 seconds until the pain limit, in order to improve muscle elasticity and trophicity from local level. These sessions were carried out at the end of the recovery program for preventive purposes, contributing to post-exercise recovery.
PHASE IV- Weeks 13-16 Socio-professional reintegration OBJECTIVES: - Maximization of functional parameters; -Improving static and dynamic balance; -Increasing tolerance to effort; - Socio-professional reintegration;	The exercises and techniques used in this stage were performed with high intensity and the number of neuromuscular units mobilized simultaneously was much higher compared to the previous phases, performing mechanical work. The strength and resistance exercises respected the principles of progressivity and regressivity of effort, increasing the tolerance to effort with a positive impact on the cardiorespiratory system. Engrams of the motor act were acquired progressively, with increasing intensity through proprioceptive, visual and auditory feedback. Physiotherapy exercises were fundamental at this stage, being structured as follows:

- circuit type exercises continued from the previous stage but adapted according to the proposed objectives;

-stability exercises that involved the manifestation of tonic postural reflexes and the simultaneous contraction of the muscles;

-exercises that improve static and dynamic balance (the patient in orthostatism, with unipodal support, the supporting knee slightly flexed, performs touching of objects positioned on the floor at different angles with the collateral limb levitating in the air);

- strength exercises with increasing difficulty by alternating isometric and isotonic contractions;

- jumping exercises with controlled changes of direction;

Fitness exercises were progressively resumed at the end of this period, press exercises and those that caused discomfort at the time of execution were avoided.

At the end of the recovery period, the patient was informed about the need to continue preventive exercises to avoid recurrence and degradation at the joint level.

Results

The recorded results are presented in the form of tables and graphs.

The initial measurements were carried out at the beginning of the second stage, the intermediate ones in the third stage – week 10, and the final ones in the fourth stage, at the end of the recovery period.

The reference value represents the measurements taken in the healthy lower limb.

Figure 1. Profile X-ray

Figure 2. Front X-ray

Figures 1 and 2 show the profile and front radiographs taken immediately after the fracture had taken place.

Figure 3. Profile X-RAY

Figure 4. Front X-Ray

Figures 3 and 4 show the profile and front radiographs, which were taken during the 3rd week of recovery, when the patient was under a plaster cast.

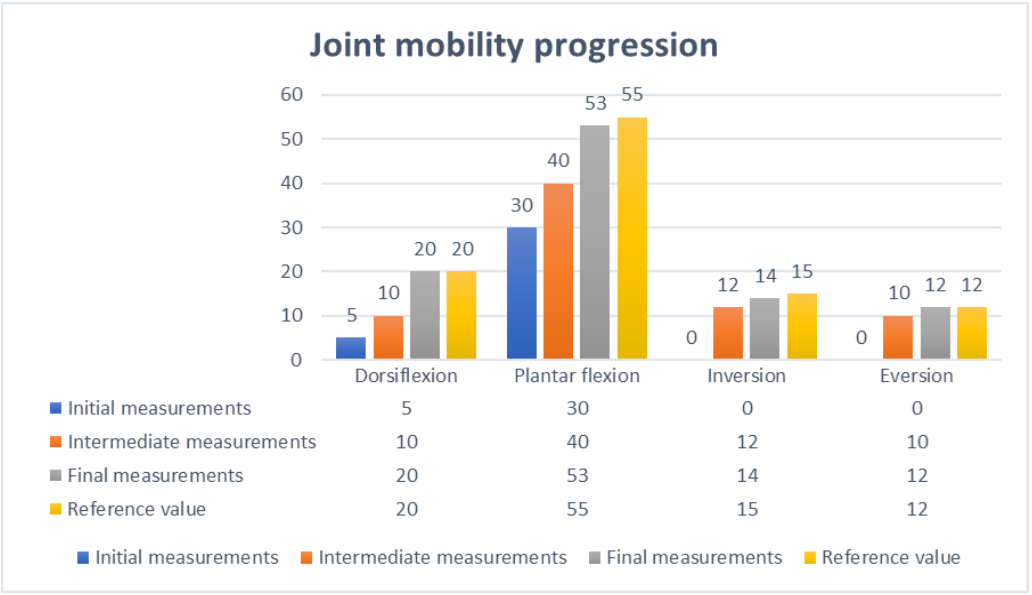

Figure 5- Joint Mobility

The mobility of the ankle is represented in Figure 5. The initial measurements recorded a low mobility which was the consequence of the trauma, the prolonged immobilization and the existing inflammatory process. Dorsiflexion movement was

limited due to muscle imbalance between agonists and antagonists, with the triceps surae being much stronger than its opponent, the tibialis anterior. The final measurements show a considerable improvement in joint flexibility in all talocrural movements, and functionality was successfully restored at the end of the recovery period.

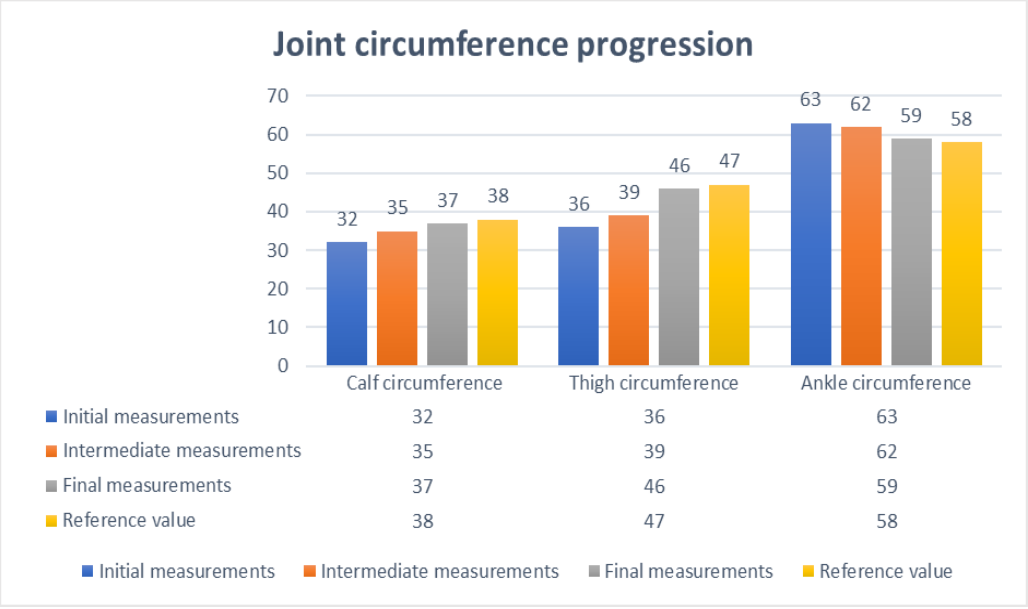

Figure 6. Joint Perimeters

Figure 6 represents the perimeters at the calf level of the thigh but also at the ankle level The ankle perimeter was measured with the metric tape, being positioned at the following strategic points: the tuberosity of the navicular bone, the base of the styloid process of the fifth metatarsal, the distal portion of the internal malleolus, the distal portion of the external malleolus and at the level of the tibial anterior muscle tendon [14]. Following immobilization and prolonged rest, the muscle tone of in the fractured limb decreased significantly on all muscle units involved in movement. Later, under the action of the mechanical work performed through specific physical exercises, the muscle balance that had been lost before was restored. The reference value represents the measurements taken at the level of the opposite lower limb.

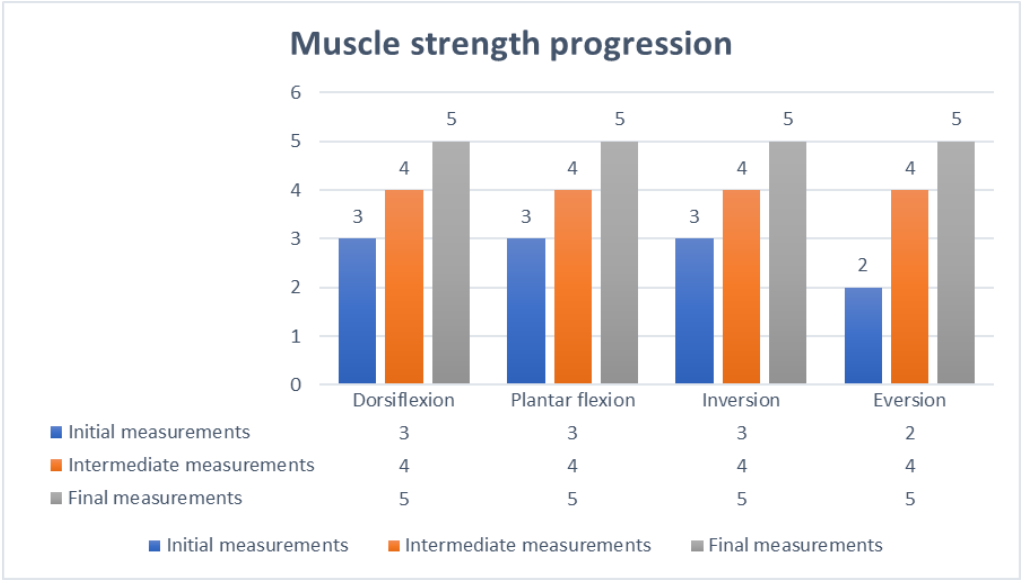

Figure 7. Muscle strength

Muscle strength was lost with the decrease in muscle tone, this fact is exposed in Figure 7. The lowest value was F2, recorded on the eversion movement, which signifies on the MRC scale, the impossibility of performing the movement against the force of gravity. The F5 value signifies a maximal force, the patient being able to perform exercises with high resistance.

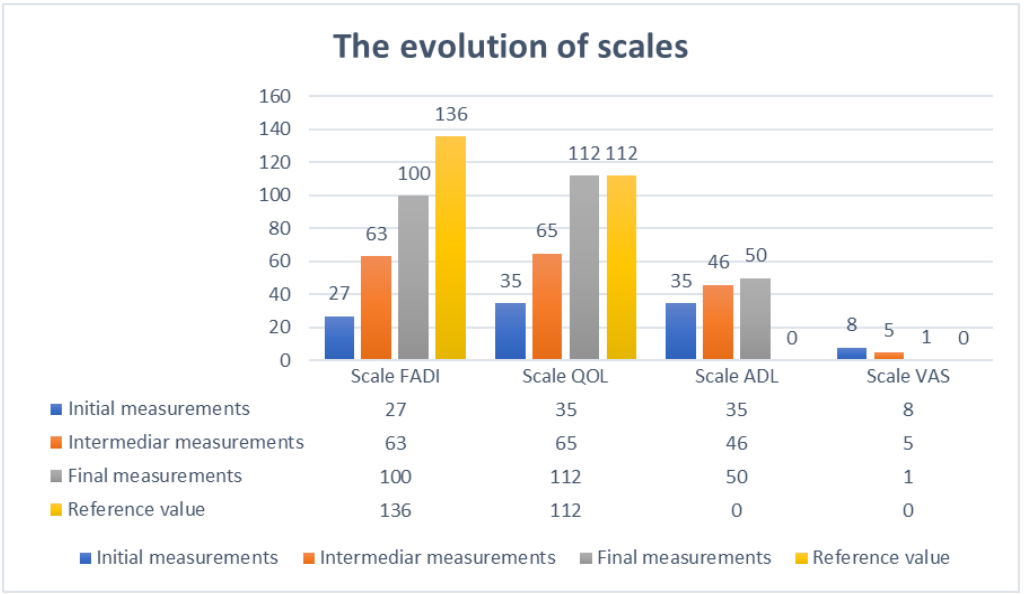

Figure 8. Scales Used

Figure 8, presents the scales used. Thier evolution during the recovery period are highlighted above. Ankle and foot disability was monitored using the FADI scale, consisting of several sections divided by different activities such as: walking, walking on an incline, sports activity and some questions that assess pain at different times of the day. At the first assessment, I obtained a score of 27 points out of a possible maximum of 136, because the patient could not perform a good part of the activities presented or performed them with great difficulty. Following the indications and progressive exercises structured by the recovery team, the disability gradually decreased, functionality was successfully restored. The FADI scale, at the last evaluation, registered a score of 100, demonstrating the effectiveness of the recovery plan applied.

The ADL scale assessed the patient's level of independence, in performing daily activities such as: personal hygiene, dressing, eating and other present aspects. Initially, a low degree of autonomy was recorded, due to the immobilization in a cast but also the assisted movement with crutches over short distances. After obtaining joint mobility, muscle strength and functionality, the ADL scale presented a satisfactory score.

The VAS scale assessed the pain experienced by the patient during recovery. The highest value was obtained at the beginning of recovery, being the consequence of prolonged immobilization and the existing inflammatory process; later this marker was controlled by cryotherapy, prone posture and physiotherapy applied to the painful site.

Discussions

Conservative treatment in the case of a bimalleolar fracture implemented in a young patient must be approached with caution, because these types of injuries present a high degree of instability, and the risk of associated conditions increases exponentially over time depending on the recovery treatment applied.

Placing the affected limb at rest under a plaster cast is the first elementary stage of recovery, to promote the healing of osteoligamentous injuries. During this period, it is important to carry out radiological control, prevent complications by maintaining a prone position and maintain muscle tone in the unaffected compartments.

As a result of prolonged immobilization, an imbalance between agonists and antagonists, that achieve dorsal and plantar flexion from the lower level, occurred. After the removal of the fixed orthosis, it is important to obtain muscle synergism and gradually improve dorsiflexion to avoid muscle shortening. The passive, passive-active mobilizations and the techniques used gave results and the muscle balance was restored.

Proprioceptive neuromuscular facilitation enhanced the voluntary motor response by stimulating proprioceptors. Slow reversal, slow reversal with opposition,

and repeated contraction techniques increased joint flexibility, promoting controlled mobility through concentric and eccentric contraction patterns that targeted hypotonic muscles to restore muscle balance.

The principle of progression was used in bearing weight on the affected ankle but also in performing kinetotherapeutic exercises. The passive, active free and active mobilizations with resistance improved joint mobility, muscle strength, while also reducing tendinous adhesions and joint stiffness felt by the patient in the second stage. The intensity of the exercises was correlated with the level of pain suffered, being consistent with the recovery protocol applied. Physiotherapy exercises were the basis of this patient's recovery because they improved functionality, dynamic stability contributing to the fracture consolidation process.

Therapy with physical agents along with cryotherapy addressed edema and pain management. By applying the diadynamic current, the short period, it was aimed to decrease the pain and obtain the resorptive effect, and the application of ultrasound produced analgesia, contributing to the regeneration process. Modulating the intensity and dosage of the procedures agreed by the medical team, showed a positive response, obtaining the desired effects.

Progress control was monitored using scales and measurements that are validated by the scientific community. These tools are indispensable to the recovery team because they measure progress, are low cost, and can be performed regularly, whenever the situation dictates.

Following the achievement of functionality at the talocrural level and the restoration of neuromuscular coordination, an important step is the exercises and techniques with the role of professional reinsertion to restore the patient's comfort and socio-professional utility that she had before the injury.

Compliance with the indications from the medical team and effective communication between the orthopedist and the recovery team is fundamental to provide the patient with a successful medical procedure in order to increase and improve the quality of life for a long time.

Conclusions

Bimalleolar fracture is a severe trauma that causes significant instability in the lower section. The conservative approach comes with a set of advantages and disadvantages that require evaluation by the medical team that balances: the severity of the condition, the age of the patient and the subsequent risks to which he is exposed.

The recovery plan was composed of: kinetotherapeutic exercises, therapy with physical agents and a series of prophylactic rules that came in support of bone consolidation forming a unitary whole in symbiosis.

Rest time in a cast, periodic radiological control, gradual weight loading of the ankle, and increasing resistance exercises are necessary to provide the proper substrate for connective tissue formation, avoiding poor consolidation.

Socioprofessional reinsertion is fundamental in recovery because it reorients the patient or introduces him to the activities he previously performed, giving him long-term autonomy and confidence.

The conservative treatment applied by the multidisciplinary team gave the expected result; the functionality in the lower compartment was restored, the pain was successfully reduced and the patient resumed his daily activities that he previously performed.

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