

Early physiotherapy rehabilitation of the distal tibia and fibula fractures after fixation – a case report

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Abstract:

Introduction: The surgical treatment of an unsteady ankle fracture consists of the anatomic recovery of bones and ligaments and the structures that surround the ankle. Regardless of age, gender, profession, or physical activity level, if possible, the preferred procedure should be an open reduction internal fixation (ORIF) surgery because this method has been proven to shorten the treatment period while being harmless to the overall health. The treatment of these injuries using the minimally invasive plate osteosynthesis (MIPO) technique can minimize the damage to the soft tissues as well as the damage to the vascular integrity of the fracture fragments.

Problem Statement and Approach: The patient was a 30-year-old professional football player, playing for the Kosovo super league, without other associated disease. The athlete suffered an injury resulting in the fracture of distal tibial and fibular bones, which that require her to undergo an ORIF surgery to fixate the fractured bones.

Materials and Methods: In this study, the following steps were followed: interview with the patient, analysis of medical reports, functional diagnostics, physiotherapy, kinesiotherapy, and implementation of nutritional programs.

Results: A well-planned and executed rehabilitation program enabled the subject to return to the highest levels within a short recovery time period (by the 20th week). **Discussion and Conclusion:** Considering the early intervention, the type of surgical procedure, the strong motivation and psychological state of mind, and the constant application of the therapeutic plan during every stage of the abovementioned protocol allowed the subject to initiate the situational individual training with his trainer starting from the 16th week. The cooperation of the patient, his motivation, and the application of the physiotherapy intervention program according to evidence-based practice have been primary and contributory factors in his return to sports.

Keywords: female player, ankle, ORIF, post-surgical management, bone

Introduction

Ankle fractures emerge as a rather common problem, with an incidence ranging up to 174 cases per 100000 adults per year (Goost et al., 2014). The healing process is often complicated, multidisciplinary and time dependent. Post-traumatic surgical rehabilitation after ankle fractures presents a very important aspect on the optimization of recovery, including the healing itself, restoring the function, preventing complications, as well as promoting the long-term functional outcomes (Balaji et al., 2021).

When this process is conducted in athletic populations, it becomes even more important particularly on the time period to return to match. Nonetheless, another important factor to take into consideration is the fact that athletic populations have already presented a better bone mineral density, geometry and strength values in comparison to their non-athletic counterparts (Boshnjaku et al., 2015; Lozano-Berges et al., 2018; Malina et al., 2021), allowing us to explore the more appropriate rehabilitation pathways to follow. It is a fact that treatment methods of ankle fracture existed since the beginning of human itself. However, the oldest evidences date amongst the traces of treatment found in the mummies of ancient Egypt (Reisner George, 1910).

In the modern medicine, the operative treatment of ankle was affirmed by (Lambotte, 1913), whereas by (Robert Danis, 1949) recognized the need for fracture fragments compression while systematically studying ankle treatment. An ankle fracture is an exhausting injury, it should be highlighted, in particular if the fracture is unstable. The surgical treatment of an unsteady ankle fracture consists of the anatomic recovery of bones and ligaments and the structures that surround the ankle. Nowadays, technology and surgical orthopedic and traumatology techniques have advanced considerably, ensuring a quick return to the everyday routine (Pagliaro et al., 2001). Regardless of age, gender, profession, or the general level of physical activity, if possible, traumatic

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fractures should undergo the open reduction internal fixation (ORIF) procedure, because it shortens the needed treatment period while being harmless to the health (Yoon et al., 2014). Unstable fractures of the distal tibia which are not suitable for the intramedullary implant are usually treated by internal or external fixation, or through a non-operative method. The treatment of these injuries by using the osteosynthesis techniques of minimal invasive plates (MIPO) can minimize the damage in the soft tissues, as well as damage the vascular integrity within the fracture's fragments. Fractures themselves were classified according to the Association of Osteosynthesis (AO) system, whereas the intra-articular extensions were thoroughly described by (Touloupakis et al., 2023).

Following the Orthopedic Trauma Association (OTA), tibial shaft fractures are classified in three types: (A) unifocal fractures and the subdivision into groups based on how the fracture line is angled and whether or if there is a fibula fracture; (B) wedge fractures that are subdivided into spiral bending or fragmented wedges; (C) more complex fractures that include complex spiral fractures, comminuted fractures, and segmental fractures (Orthopaedic Trauma Association (OTA), n.d.).

The post-surgical and weight bearing rehabilitation protocols are significant for the results of fracture fixation, though a lack of worldwide consensus regarding the treatment after the fracture plate and extremities fixation prevails. This lack of consensus has led to different practical guides and potentially beneficial protocols within the matter. The availability of many different rehabilitation devices to enhance and facilitate the rehabilitation process (Dostalova et al., 2022) does no good to the matter either, while making the situation even more complicated. In the systematic review made by (Iliopoulos & Galanis, 2020) early range of motion exercises and weight bearing have been encouraged after the surgical procedure as well the quadriceps strengthening and proprioception exercises were recommended among other physiotherapeutic interventions. This implies that even though being presented as common conditions, the rehabilitation of injuries from the lower extremities emerge as complex problems for all stakeholders on the recovery process (Hoyt et al., 2015). Having this in mind, this case report aimed describing such a situation (post-surgical rehabilitation and treatment protocol after the distal fibula and tibia fracture) from the perspective of a young female professional football player while following the best-known practices on the rehabilitation process.

Case presentation

Patient is a professional football player, who plays for the Kosovo Super Ligue. He is thirty years of age and has not had any other concomitant diseases, except for a right leg hamstring muscle injury that occurred nine years ago. On the 21st of May 2021, during a football game, the patient suffered an injury of high intensity on his left foot by an opponent while attempting to retrieve the ball. Even though the patient was wearing the safety equipment's, the collision strength was direct with high intensity, thus causing a crural injury in the left region. The first aid was given to the patient by the medical staff in the football field immediately after the accident, wherefore the lower left extremity was mobilized with a splint and the patient was transported to the Emergency Clinic within the University Clinical Centre of Kosova (UCCCK) in Pristina.

The athlete was awake and conscious when the process of admission to the emergency center occurred but was undergoing enduring pain of high intensity in the left cruris region. A radiological scan of legs X-ray graph was performed by the emergency medic, with a highly visible fracture of distal cruris (Figure 1 a. and b.). The orthopedic surgeon immediately decided on a surgical intervention and fracture fixation, which underwent on the same day immediately after the pre-operative preparations (including the laboratory analysis and consultation with the anesthesiologist). The surgical procedure was decided to be performed under spinal anesthesia. Laboratory analysis upon acceptance were as follows: leucocytes = 18.0, erythrocytes = 5.38, hemoglobin = 15.5, hematocrit = 44.1, thrombocytes = 242, glucosis = 4.67, urea = 9.68 and creatinine = 138.6. The patient was hospitalized in the orthopedic clinic during the period between the 21st and 24th of May 2021. From the admission until the release, patient was in a stable condition with normal vital parameters and laboratory reports, as shown in the release forms by the orthopedic clinic.

While hospitalized patient was treated with intravenous solution containing NaCl Sol 0.9% of 500ml every 12 hours and ranitidine 50mg ampoule every 24 hours, diclofenac sodium ampoule 75mg (as required, for analgesic purposes), fraxiparine ampoule 0.4ml every 24 hours (for anticoagulation) and ceftriaxone ampoule of 2gr every 12 hours (antibiotics to prevent infection). Upon release, patient had a good local and general condition, with laboratory analysis as follows: leucocytes = 10.0, erythrocytes = 4.18, hemoglobin = 13.3, hematocrit = 35.7 and thrombocytes = 109. Ordinated following therapy included ampoule fraxiparine 0.4ml every 24 hours, amoxiclav tablets 1.0 every 12 hours, ibuprofen tablets of 400mg (as required) and would cleaning every 2 days. Physiotherapy treatment following the postoperative protocol began immediately after the surgery on the very first day within the orthopedic clinic.



Figure 1. a. RÖ regio cruris lat sin before surgery; b. RÖ regio cruris lat sin post-surgery

Materials and methods

Interview with patient

After the release from the Clinic of Orthopedics with Traumatology, patient went to the Physical Rehabilitation Clinic - Sports Medical Centre. At the moment of admission, the patient was conscious in time and space, and was stable in the hemodynamic aspect as well, under anti-inflammatory therapy, antiallergics, anti-coagulants, and had a cast placed below the knee towards the left foot. During the interview, the patient explains the situation of injury and everything that he had gone through during and after the surgical intervention. Additional information about the injury's cicatrix and superficial structure were collected, aiming to observe for potential infection or bleeding, which resulted to be negative. The patient has given a negative response on having other concomitant diseases, may those be acute or chronic ones.

After the assessment of the documents and the interview, the patient was informed about the importance of physiotherapy and the treatment planned. Furthermore, he was also informed about the expectations of the beginning of physical therapy along with standard protocols according to which he has to work to have a quick physical recovery, precisely in his activity as a football player. At the end of the interview, the patient understood thoroughly the process of physiotherapy program under the umbrella of professional football player-oriented rehabilitation and had agreed to start the physiotherapy program.

Medical Report

The assessment of the medical documents and records included: The rapport of the Emergency Clinic of the UCCK. RÖ regio cruris lat sin before and after the surgery (Figure 1 a. and b.) The detailed medical release form by the Orthopedic Clinic within the UCCK about the approach on the internal fixation of crural bones, extra guidance on the medicament therapy for the patient, and the recommendation to start the physiotherapy rehabilitation program.

Functional diagnostics

With the completion of the interview, as well as the analysis of the documents and medical records, the following diagnosis was described by the responsible orthopedic surgeon: Dg: Fractura cruicis distalis lat sin, OP: Repositio operata osteosynthesis cum plate, drainage nr. I, Immobilization gypsum (Longette). Throughout the physical examination, firstly we have performed the inspection, according to which no signs of risks for infection or bleeding was noticed. During the initial palpation, a slight edema in the region of cicatrix was noticed, which was in relation with the extremity on the opposite side with a difference of about 2 centimeters as assessed using a measuring band. During the examination, we assessed the blood circulation in the dorsal pedis artery, and the sensitivity, and there was no eventual problem noticed in regard to the blood circulation. Additionally, we have assessed for eventual damage in the peripheric nerves in the lower left extremity, which resulted as negative. The muscular assessment which was done according to the Manual Muscle Test (TMM) about the close front and back regions of the hip, the cruris, and the affected part of the heel, found out that there was a minor difference in the strength production on the quadriceps and hamstring muscles in comparison to the muscles of the opposite side with a 4+ grading assessment on the manual strength. Furthermore, the crural region was examined even though the patient experienced a slight pain and was under the effect of analgetic. In this case we observed (following TMM) that the front and back muscles of the cruris produce strength with a grading assessment of 2+. As for the articular assessment, the Golden assessment was done, Geni for ROM as well as the Talocrural (T/C) and Subtalar (S/T) articulation. The Geni articulation resulted with no limitation on the passive and active movements in this joint, whereas the T/C articulation resulted in a limitation of the ROM in the direction of dorsiflexion, with a 10-degree absence of active completion, absence of Planar movement completion with flexion of 15 degrees. Heel inversion and eversion were relatively close to the physiological norms of movement. The assessment was done using a goniometer by constantly comparing the opposite side. After the physical examination, the physiotherapeutic diagnosis was determined: Contracture art. T/C let sin, St. Post OP Reposition aperata osteosynthesis cum plate, drainage nr. I, St. Post. Fractura cruicis distalis let sin.

Physiotherapy program

Physiotherapy program was created based on evidence-based practice. In the initial stage of protocol implementation, the patient was instructed to not put weight on his limbs and to hold the foot raised on the level of the heart. In the second week, in concordance with the orthopedist's recommendation, the longest open plaster cast is removed, and the assessment of the injury is done, to detect any possible infection. In this stage, the aforementioned procedure continued until the 6th week of the rehabilitation, and it continued according to the orthopedist's recommendation. 6 weeks after the surgery, we started with gradual weigh carrying and the protocol described in Table 1 was applied.

Table 1. Rehabilitation Protocol form [9]

	Phase I 0-2 week	Phase II 2-6 week	Phase III 6-23 week	Phase IV >12 week
	Inflammation Swelling Control	Early ROM	Strengthening Proprioception	Return to Activities or - Sport
Modalities	Elevation Cryotherapy	Elevation Cryotherapy Compression Stocking Aquatic therapy TENS Ultrasound	Elevation Cryotherapy/heat Compression stocking Aquatic therapy TENS Ultrasound Manual therapy Active-release/massage	Elevation Cryotherapy / heat Compression stocking Aquatic therapy TENS Ultrasound Manual therapy Active release /massage

FWB, full weight bearing; NWB, non-weight bearing; TENS, transcutaneous electric nerve stimulation; WB, weight bearing; ROM, range of motion.

Kinesiotherapeutic program

The physiotherapy program was accompanied by a kinesiotherapeutic program (table 2) which was planned in total four phases. The first phase (0-2 week) was concentrated on controlling inflammation and swelling, as well as on preserving the ROM in the other neighboring joints, always under moderate carefulness. The second phase (2-6 week) started adding some basic stress to the recuperating joint, thus aiming to start directly working on the joint. This was a very delicate phase where every step was conducted within the bearable level of pain. The main aims of this phase were maintaining the ROM and strength and preparing the region for further progression of the exerted load. The third phase (6-12 week) continued progressively adding more stress to the rehabilitating joint alone and associated to the other joints surrounding it. 3+ level of pain was set as the threshold for this phase. The final fourth phase started on the 12th week and continued onwards until reaching the capabilities to return to match. Before every days initiation of rehabilitation program, a set of plain passive stretching of the musculature around the T/C joint was performed as a means to release and relax, notwithstanding the lack of effectiveness passive stretching has shown on enhancing the outcomes for post ankle fracture plantar flexion contracture after cast immobilization (Moseley et al., 2005). It is important to notice that the level of prescribed strength exercises was constantly based on the self-reported pain level scale following the 0-10 pain assessment criteria, whereas the strength itself was assessed following the 1-5 grading scale (0 - no contraction, 1 – noticeable contraction but no movement, 2 – movement only when eliminating the gravity, 3 – movement against gravity, 4 – movement and contraction to submaximal resistance, 5 – movement against maximal resistance) (Ciesla et al., 2011). Finally, in order to get a “green light” to return to play, the patient had to have a full ROM with maximal strength (grade 5 out of 5) and no pain (0 out of 10).

Table 2. The kinesiotherapy program is described below

	Phase I 0-2 weeks	Phase II 2-6 weeks	Phase III 6-23 weeks	Phase IV >12 weeks
	-Inflammation -Swelling Control	-Early -ROM	-Strengthening -Proprioception	-Return to Activities or Sport
Weight-bearing	NWB	Stable ankle Begin protected - WB Unstable ankle - NWB Pilon - NWB Talus - NWB	Stable ankle - FWB Pilon - protected WB (>8 weeks) Unstable ankle - FWB Talus - protected WB (>8 week)	Stable Ankle - FWB Unstable Ankle - FWB Pilon - FWB Talus - FWB
Immobilization	Below-knee plaster splint	Stable ankle - below-knee cast boot (PRN)	Stable ankle - none	None

		Unstable ankle - below-knee cast boot Pilon – below-knee cast boot Talus – below-knee cast boot	Unstable ankle - wean cast boot Pilon - below-knee cast boot Talus - below-knee cast boot	
Range of motion	Toe wiggling Knee ROM Hip ROM	Stable ankle - begin WB ROM exercises Unstable ankle - NWB ROM exercises Pilon - NWB ROM exercises Talus - NWB ROM exercises	FWB ROM exercises	FWB ROM exercises
Strengthening	Straight-leg raises	Straight-leg raises	Isotonic strengthening	Isotonic strengthening Plyometrics Sport-specific training
Proprioception			Gait training Single-leg stance Inversion-eversion boards Mini-trampoline	Gait training Single-leg stance Inversion-eversion boards Mini-trampoline Sport-specific exercises

Nutrition program

Nutrition program was created based on evidence-based practice. A nutritional intervention process followed the rehabilitation process, which included the patients education to increase components that have already been suggested for an association with musculoskeletal system, including calcium, vitamin D, electrolytes, iron and vitamin C. Patient was encouraged to aim taking roughly 1500 milligrams of calcium on daily basis, and include in the diet products like milk, yogurt, green lettuce, salmon, cheese, broccoli, and K2 vitamin. Furthermore, he was also suggested to take phosphor in an appropriate quantity (through milk, cheese, yogurt, walnuts, oat, and sardine) magnesium (through peanuts, tofu, broccoli, spinach, swiss chard, walnuts, and seeds), and Omega 3 which assists in athletes’ development of muscular system and strength.

Discussion

This case report describes the situation of a 30-year-old professional football player suffering a fracture of the lower distal leg (official diagnosis: “fractura cruris distal lateral sinister”), with an emphasis given towards the post-surgical physiotherapeutic rehabilitation process. It has been shown previously that to date there is a lack of reports describing the outcome process for distal tibia and fibula fractures amongst athletes, notwithstanding the fact that ankle and the surrounding tissues present the region suffering roughly 10-15% of all athletic injuries (Porter et al., 2008). Furthermore, controversies on the more accurate and applicable approach to follow within the post-surgical management process exist, depending on many factors such as the age of patient, strength of the installed construct, patients adherence towards non weight-bearing suggestions, the past time in between the index operation and patients discharge, or even other related injuries or conditions (Dwivedi et al., 2020). While considered as a frequent, easy, or simple healthcare condition, it often provides ground for complications due to miscalculations and misunderstandings, thus leading towards unnecessary delaying’s on the much important return to the field (when dealing with athletes). This neglecting situation faces clinicians with serious professional dilemmas when dealing with such cases, particularly in regard to the scarce rehabilitation options on the better and more meaningful approach to follow. Traumatic injuries are frequent and of high intensity within athletes (Robertson et al., 2012). Tibia-Fibular fractures (particularly) amongst athletes, have been seen in earlier publications (Boden et al., 1999), whereas we aimed to show that the surgical fixation needs to be followed by an individually tailored rehabilitation program. Physiotherapeutic approach in particular has shown a major efficiency of success in these injuries (Torino & Mehta, 2016). The prognosis of return to the sportive activities after the tibia-fibular fractures has been reported to be approximately 40 weeks by (Boden et al., 1999) notwithstanding the potential influence exerted by other factors. Quite differently, another study describing a retrospective case series from Porter DA and colleagues (Porter et al., 2008) reported a return to the pre-injury competition levels in a range within 2 – 4 months, though with minimal pain or functional morbidity. In view of our case study, while considering the early intervention, the type of chirurgical intervention, the strong motivation and psychological state of mind of the patient, the individually planned tailored-based rehabilitation program has made it possible to start with the situational individual training with his trainer starting as early as the 16th week and 8returning to the fields of football by the 20th week. The novelty in our case is that the patient / athlete returned to play with level 0 pain (within the 0 – 10 scale) and no functional morbidity whatsoever. This can be a good starting point for the community of practice to plan using similar approaches in their clinical practices.

Conclusion

This case study targets an issue of great importance in sports characterized with high impact collisions. Lower leg injuries are common though devastating conditions, with potentially serious implications for the athlete's recuperation and future performance. In this context, we propose a novel treatment protocol which we used for our subject (30-year-old female professional football player) which emerges to be promising for future applicability in clinical practice. Our case demonstrated that after the surgical fixation, the cooperation of the patient, her motivation, and the application of physiotherapy has been primary and contributory factor in her return to sports. However, other studies have already emphasized the importance of other factors such as the psychological and emotional states on the predicting process for returning to sports after an injury (Ardern et al., 2013). We suggest that it is of great importance to first and foremost follow strictly the international guidelines on dealing with injuries in athletic populations (Harmon et al., 2013, 2019; Hodax et al., 2017; Rozzi et al., 2018), while adjusting these tailored to the population specific characteristics. It should be noted that rehabilitation protocols differ not only based on the type of sport and injury per se, but also based on the individual characteristics and multidisciplinary team approach toward the patient. In this line, we believe that early rehabilitation of distal tibia and fibula fracture after fixation should not necessarily be only a matter of physical rehabilitation, but it should be a multidisciplinary process stretched out in multidimensional contexts including psychological, nutritional, and motivational aspects.

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Data Availability Statement: On request, the corresponding author will provide access to the data used in this work.

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Conflicts of Interest: The authors say they have no competing interests.

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