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Ankle Sprain, Physiotherapy from the Evaluation of the Injury, the Assessment of its Severity to the Restoration of Podal Movement

Entorse de la Cheville, Physiothérapie de L'évaluation de la Lésion, le Constat de sa Gravité Jusqu'à la Restauration du Mouvement Podale

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Résumé

Le traitement des entorses a longtemps a été très controversé entre les partisans de la réparation chirurgicale primaire et ceux du traitement par immobilisation (plâtrée, attelle, etc.) ou par traitement fonctionnel (orthopédique et kinésithérapique). Pour des raisons anatomiques et physiopathologiques, de risque de laxité, d'instabilité et de récidive. Le traitement fonctionnel est toujours d'actualité pour l'entorse de la cheville. Il englobe: une immobilisation relative par strapping ou orthèse semi-rigide et une mobilisation articulaire précoce. Cependant, parmi les techniques de rééducation proposées, beaucoup n'ont pas fait l'objet d'études comparatives. Aucune étude comparative en Europe central et de l'est n'a été identifiée. Des moyens de mesure fiables existent tout de même pour attester l'efficience des techniques. La reprogrammation neuromusculaire est de mise dans ce processus au regard des récepteurs proprioceptifs animant le schéma équilibre, marche et cervelet d'un côté, et douleur, réaction post douleur, contrôle moteur et réponse proprioceptive de l'autre côté. Nous proposons dans cette revue générale des mis au point, certes pas nouvelles, mais récapitulatives, vivifiée et associées, et luminées notre expérience clinique.

Mots clés: Entorse De La Cheville; Traitement Fonctionnel Des Entorses De La Cheville; Kinésithérapie Des Entorses; Lésion Du Ligament Latéral Externe; Protocol GREC

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Abstract

The treatment of sprains has long been highly controversial between proponents of primary surgical repair and those of treatment by immobilization (cast, splint, etc.) or functional treatment (orthopedic and physiotherapy). For anatomical and pathophysiological reasons, risk of laxity, instability and recurrence. Functional treatment (physical treatment) is still relevant for the ankle sprain. It includes relative immobilization by strapping or semi-rigid orthosis and early joint mobilization. However, many of the proposed rehabilitation techniques have not been the subject of comparative studies. No comparative studies in Central and Eastern Europe have been really identified. However, reliable means of measurement exist to attest to the efficiency of the techniques. Neuromuscular reprogramming is more and more required in this process with regard to the many proprioceptive receptors animating the balance, walking and cerebellum pattern on the one hand, and pain, post-pain reaction, motor control and proprioceptive response on the other. In this general review, we propose some developments, certainly not new, but summarizing, invigorated and associated, and illuminating our clinical experience.

Keywords: Ankle Sprain; Functional Treatment of Ankle Sprains; Physiotherapy of Sprains; External Lateral Ligament Injury; GREC Protocol

Introduction

The foot is strongly involved in movement, and in the practice of all sports by its essential role in locomotion, propulsion and adaptation to the ground, even by its use as a sporting instrument. The bony, tendino-muscular, cutaneous and ligamentary structures of the foot are subject to strong stresses, as well as multiple traumas and microtraumas. The ankle is that part of the lower limb of the human being, located between the lower extremity of the leg and the foot, and comprising the tibiotarsal joint and the malleoli. It is considered by health professionals (foot specialists) to be the «instep», which demonstrates its observed importance, similar to the neck that connects the trunk of the head. The sprain is a capsulo-ligamentary lesion caused by too much tension or repeated micro-trauma. It represents 6,000 cases per day in France and 24,000 cases per day in the United States of America. It constitutes a traumatic emergency, and a third of these sprains are serious. Among the patients, 60% are aged between 25 and 44 years, and 64% are men. The fibular collateral ligament or external ligament (CLL) is 90% the most recurrent ankle sprain and 10% for medial collateral ligament (MCL) or distal fibular tibia sprain. 20 to 40% are sports-related, and functional treatment is the most appropriate and recommended [1,2]. Therefore, the objective of this review is to review the physiotherapeutic circuit of ankle sprains, precisely the LCL in view of its immense frequency.

Anatomical reminder (cf. figure 1A to 1E)

From an anatomical point of view, the ankle comprises three joints: Tibio-talar, subtalar, and distal tibiofibular. Bone congruence is sometimes important, particularly for the tibio-talar joint, and ensures a large part of joint stability. However, it is never sufficient to respond to rotational movements or movements performed in extreme angular areas. The tendino-capsulo-ligamentary elements, through muscle tensioning and/or contraction, then play an important role, permanently facilitating good coaptation and coordination between the different bone structures. Being bipedal, most locomotive and sports activities being loaded, the ankle is exposed to frequent traumatic risks. In the light of our experience, we can differentiate between two contexts:

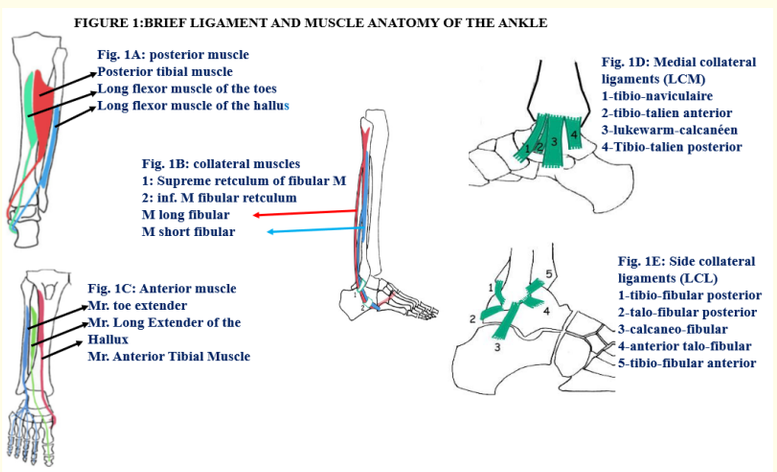

Figure 1: The anatomical structures of the ankle A to E.

- **Single trauma:** Either by a shock (kick, crampons, etc.), causing compression, or even crushing of local structures. Depending on the intensity of the trauma, the lesion may be totally benign, ranging from simple contusion of the superficial planes of the skin or ligaments, evolving favourably in a few days to severe damage (dislocation, fracture, tendon rupture, possible sources of after-effects).

- **Indirect trauma:** Straining the joint in its extreme amplitudes. It is then observed that the passive means of contention are then put under tension, or even distended, partially or totally ruptured. In the case of complete rupture, the stops represented by the bone structures become the final ramparts before dislocation occurs.

Injury mechanism of the sprain external lateral ligament sprain (ELS)

Box 1: Brief epidemiology :

- It is a traumatic emergency
- 6000 cases per day in France
  A third of them are serious
- 60% are people between the ages of 25 and 44,
- 64% male to 35% female
- 90% are lesions of the LCL and 10% medial laterals.
- Misdiagnosis is more often a source of recurrence and instability of the ankle, 10 to 15% of patients retain these after-effects.
- The functional treatment is broad consensus and recommendation
- 70% recurrence after conservative treatment
- -Up to 93% of intra-articular lesions are associated [2,3,4,6].

Box 1

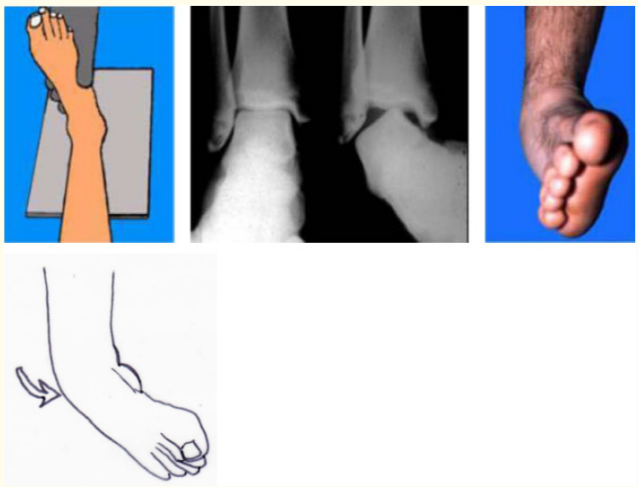

Figure 2: A and B: Dislocation with fracture observed in the clinic (A) and on imaging (B).

The causes and mechanisms of LCL sprains are always in the external inversion of the ankle. Ankle sprain is the consequence of false lateral movements. These occur while running (change of direction), by placing the foot incorrectly on unstable or uneven ground or when skidding on poor ground (exceptional in competitive athletes) or by rolling on the ball, landing on the foot. The ligament suffers during a trauma, during a sporting activity but not only. Most often, the weight is placed on the ankle twisted in equinus varus (See figure 2A, 2C and 2D), a misstep, poor reception of a jump, or a sports accident with a forced inversion mechanism that causes the ligaments to stretch beyond their limits. Contrary to some sports such as skiing, which have been able to observe a decrease in the number of ankle sprains thanks to the widespread use of shoes that completely immobilize the ankle, the ankle remains extremely exposed in soccer and rugby.

What approach to take when faced with a strange approach?

Elimination approach

Is it a fracture? (See figure 3A and 3B), below.

If the fracture is clear, we continue the research: Is it a dislocation? (Cf figure 4A and 4B).

Figure 3: A and B: Dislocation with fracture observe the clinic (A) and on imaging (B).

Dislocation by a complete loss of congruence between cular surfaces, the bone ends are displaced relative to ea In an ankle dislocation, the distal ends of the tibia-fibula, t caneus, cuboid and navicular are unstable. See figure below. In a subluxation, the two articular surfaces present an incongruence, but the loss of contact is incomplete.

Figure 4: A and B and C: Clinically observed fracture-free dislocation correlated in radiography.

If it is therefore not a fracture or disuxedr as a result, the diagnostic noose tightens around the sprain (see figure 5), is it a sprain of the lateral collateral ligament? How serious is he?

Figure 5: A and B: Sprain with bruise below the malleolus, inflammation.

Pre-diagnosis action

Immediate physiotherapeutic care (see figures 6-8)

- **RICE protocol:** The GREEK protocol (or RICE in English) must be systematically applied in the post-traumatic or post-operative phase in order to: Reduce pain and the occurrence of edema, reduce metabolic activity and inflammatory reaction, exert a pump effect on the edema, promote tissue healing.

As soon as the subject limps or becomes impotent, all activity should be suspended immediately in order not to aggravate the lesion.

The first phase of the GREEK (RICE) protocol is icing: the inflammation caused by tissue damage leads to the appearance of pain and edema. The icing sends signals that reduce the sensation of pain and at the same time narrows the vessels, preventing bleeding and helping to fight the edema. The duration and temperature of icing are very important. To be effective, the icing must cool the skin until it drops to between 5° and 15°C. Once the temperature is reached, the glaze should be maintained for a period of about 20 to 30 minutes. This operation should be repeated every 2 - 3 hours (See figure 6).

The GREC protocol consists in a second phase of observing a resting phase. It is obvious that after a trauma, it is imperative to rest the limb and avoid asking for it which would result in worse-

Figure 6: Glaze, 1st imperative phase of the GREC Protocol (RICE).

ning symptoms (pain, edema). The aim is to put the traumatized joint to rest by avoiding prolonged or repeated efforts or even by advocating the partial discharge of the joint through the use of English canes.

The traumatized muscle/joint should be placed as much as possible in discharge, i.e. elevated relative to the rest of the body. A few centimetres of leg elevation in a sitting or elongated position will promote drainage and venous return. This elevation is very effective in reducing pain and swelling.

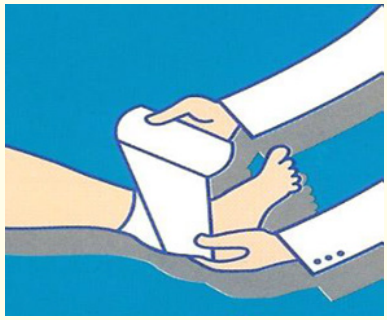

Figure 7: Bandage, 2nd phase of the GREEK Protocol (RICE).

The compression exerts a pumping effect on the injured area which will accelerate the recovery of the lymphatic and blood circuits. Compression allows the ice pack to fit perfectly into the joint or muscle, allowing the cold to penetrate deep into the tissues. The compression of the traumatized area helps to fight against the appearance of edema or to promote its resorption.

Box 2 (to remember). Basic Therapeutic Principles :

- Restoring and maintaining normal positioning of the talus under the tibia
- Ensure the best conditions for healing of damaged structures to avoid subsequent instabilities.
- Restoring the most perfect joint surface possible, and minimizing the risk of secondary arthrosis.

Box 2

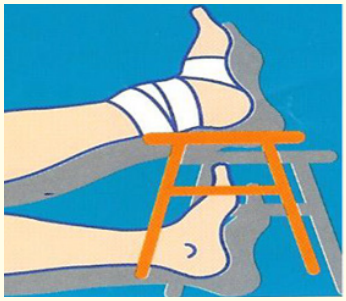

Figure 8: Elevation, 3rd phase of the GREEK Protocol (RICE).

General (Medical) diagnostic approach

Although interrogation and inspection alone are insufficient to establish a diagnosis of certainty, they nevertheless provide very important elements of guidance.

Interrogation

It is essential to locate the traumatic mechanism (varus, valgus, isolated or combined with a movement of adduction, abduction and/or plantar or plantar flexion) making it possible to establish the anatomical structures involved in the movement and therefore likely to have been injured; the intensity of the trauma, although it is far from always correlated with the degree of seriousness of the lesions; the existence of immediate signs : A feeling of tearing, an

impression of dislocation of the ankle, cracking, swelling of almost immediate appearance are signs that suggest a serious bone or ligament injury. On the other hand, the sensation of clicking is not specific. The intensity of the pain and the degree of functional impotence are not reliable signs that allow us to prejudge the extent of the lesions.

Inspection and palpation

Examination in the first hours or minutes after the injury: inspection and palpation is sometimes difficult due to the fear initiated by the pain and the psychological effect of the shock in question. Evidence of a haematoma and especially its topography directs the suspicion of injury: plantar: +++ fracture (in particular tarsal or medio tarsal) until proven otherwise. External pre-malleolar: sprain of the external collateral ligament (ECL).

Clinical examination

Two situations can occur:

The local state, the tolerability of the pain makes the ankle examinable: the assessment of mobility, both active and passive in each of the joints, the study of isometric contractions, the search for painful points on palpation will make it possible to establish a presumptive diagnosis and/or to direct possible complementary examinations, mainly X-rays and ultrasound.

The ankle cannot be examined (pain, swelling, total functional impotence): a priori, a bone lesion should be feared and an initial radiographic check-up should be requested. Depending on the results of the first check-up, this may be followed by a second, more advanced imaging (CT scan, MRI). Clinical examination in acute cases has shown its limitations in the quest for a complete lesion assessment and an accurate approach to severity. The search for the Ottawa criteria allows a validated approach to the indications of the initial standard radiographic workup [2,3].

NB: The strength of the ankle muscles is not studied at the beginning of rehabilitation. An evaluation of muscle function is only performed if there is a problem (associated pathology). The physiotherapist checks the contractility and the anatomical situation of the muscles.

In general, the diagnosis of a sprain is based on an

Box 3. The walk in consultation :

At a distance from the trauma, the diffusion of the hematoma and the occurrence of edema make these topographical landmarks less reliable. It is not advisable to give importance to the examination of the gait, and in particular to the possibility or not of support on the injured side, because here too the correlation with the severity of the injuries is far from constant. Only walking without heel detachment during the posterior step ½ is suggestive of a rupture of the calcaneal tendon.

Box 3

Positive signs of angle sprain

- Pain during the tensioning of the lateral collateral ligament: during plantar flexion of the tibiotarsal joint, during varus movements of the hind foot;
- Possible presence of abnormal laxity, indicative of rupture of at least one of the three bundles constituting the LCL: in the frontal plane: asymmetrical varus increase, presence of a heel shock; in the sagittal plane asymmetrical anterior drawer increase (cf. figure 10); pain on palpation of the ligament (insertion or travel).

And negative signs:

- Tendon testing against resistance is always possible and does not significantly increase pain (sometimes moderate pain during testing of fibular tendons indicating an associated lesion of the sheath of these tendons);
- The joint amplitudes are never increased. Clinical examination of the tarsus and mid-tarsus is normal;
- Palpation of bone markers is painless (Ottawa Criteria, Box 5) [5].

Sign of severity

Severity assessment

This is an essential step, in fact in practice, the major problem is the appreciation of the degree of seriousness of this sprain, be-

cause the treatment depends on it. It is therefore essential to know the signs which, in front of a sprain, make suspect an extensive rupture of the LLE, fibular, isolated or associated with other lesions. The clinic alone does not always resolve this diagnostic precision. Admittedly, a benign sprain is fairly easy to identify: swelling ± minimal external pre-malleolar ecchymosis; pain on tensioning the LCL/LLE during passive varus; absence of asymmetrical laxity. In the same way, a severe sprain must be suspected in front of: a spontaneous attitude of the foot in equine varus; an extensive ecchymosis appeared early (3-4 hours); the existence of a spontaneous and increased external retro malleolar pain at the resisted contraction of the fibular tendons (witness of an associated lesion of the sheath); the presence of frontal and sagittal asymmetrical laxity.

Box 4: Ottawa Criteria

(Acute ankle trauma, subject aged 18 to 55 years): An x-ray of the ankle should be requested in case of :

- The patient is unable to walk two steps on each foot without assistance within one hour of the trauma or at the time of the examination;

- Awakening pain upon palpation of the posterior half of one of the two malleoli over a height of approximately 6 cm from the tip. An X-ray of the midfoot must be requested in case of :

- The patient is unable to take two

Box 4

However, if the presence of a varus, an anterior drawer, or a heel shock is a sign of a serious sprain, their absence does not eliminate the diagnosis because they are difficult and/or painful to look for after a few hours of evolution. The fact remains that the majority of sprains are of an intermediate clinical form between these two extremes. Faced with the absence of clear signs of severity, the risk would be to underestimate the lesions. A new clinical assessment a few days later often allows a diagnosis to be made, especially if local conditions have been improved by applying ice, resting the joint, raising the traumatized limb and applying a compression bandage (GREC protocol). When doubt persists after this new clinical assessment, an imaging assessment is necessary [2,6].

Box 5: General sign of severity :

- Initial syncopal pain, discomfort

- Crackling heard

- Feeling of tearing or dislocation

- Difficult unipodal support (if immediate persistence: probable fracture and secondarily related to a sprain)

- Immediate swelling (<10 min)

- Early bruising (< 1huere)

- Foot hanging, not always!

Box 5

Medical imaging

Although the prescription of x-rays is guided by the clinical examination, in fact, many x-rays are normal, with the financial and human cost that this implies, as the irradiation remains an epiphenomenon at the ankle. The standard, bilateral and comparative radiographic check-up includes 4 incidences: frontal x-ray of the ankle; frontal x-ray in medial rotation of about twenty degrees; profile x-ray; and lateral oblique x-ray of the tarsus (unrolled from the foot).

It should be noted that the basic standard radiographic assessment generally aims to eliminate all of the confraternal and peri-geographic lesions in this type of trauma, including: an associated fracture; specifically at the anterior edge of the tibia or the neck of the talus, osteochondral lesion of the dome of the talus, posterolateral tuberosity of the talus, fracture of the tip of the lateral malleolus, cuboid, styloid of the 5th metatarsal, fibula. The dynamic images requested in the case of an ankle trauma, or suspicion of a serious sprain and in the absence of bone lesions, are taken after the paroxysmal pain of the first 3 days, in order to really

have a good radiographic incidence with regard to the oedema often released during the first hours after the trauma. These exams aim to reveal pathological evidence in the frontal (yawning) and sagittal (drawer search) planes. The search for laxity in the sagittal plane is done with the foot in equinus and the foot at right angles (cf. figure 9A-9C).

Figure 9: A: Mobilization in equine, search for laxity figure. B: X-ray showing this laxity figure. C: Lateral yawning.

Ultrasonography is the examination of choice, because it is increasingly used, it makes it possible to establish precise lesional assessments (which could be incomplete by the only clinical examination, rigorous was it) leading to an adequate treatment. Therefore, because of its safety, its rapidity of obtaining it and its affordable financial cost, ultrasound is an essential examination to establish a ligament injury assessment. Nevertheless, it is useless in the diagnosis of benign ankle and bone sprains. In addition to ultrasound, other examinations can be initiated by the clinician depending on the objectives really sought; arthrography, CT scan, IRM.

Ranks

Observation and clinical Grade I: elongation without rupture Grade II: (medium): partial rupture Grade III (severe): total rupture of at least one bundle

Box 6: Ankle sprain imaging :

- - An imaging exam will be more effective at D3 than at D 0.
- - Any ankle trauma is not an LCL sprain.
- - The clinical and iconographic assessment is crucial, it eliminates differential diagnoses.
- - The standard radiography is the 1st intention imaging, followed by the ultrasound,
- - The other examinations (CT scan, MRI) must be guided by the clinical assessment.

Box 6

Box 7: Classification of sprains

- - Benign sprains correspond anatomically to a simple elongation of the LCL bundle.
- - Medium-gravity sprains correspond anatomically to a partial rupture of the LLE bundle.
- - Severe sprains correspond anatomically to a complete rupture of the LLE + /- associated with other lesions and antero-posterior bundle.

Box 7

Initial cracking +/- +/- +

Initial pain Just the 1st hour + ++

Walking +/- limping the 1st hours Difficult support the 1st hours Difficult or impossible support in unipodal mode

Swelling/inflammation Moderate lateral swelling and swelling

Skin lesion Deep skin lesion, ecchymosis

Ecchymosis - +/- + + (Lateral, then diffuse)

Passive Varus Sensitive Painful +

Painless Sensitive Front Drawer +

Palpation of LTFA or LLE Sensitive, slight pain Pain + Pain ++

Grades Observation and clinic	Grade I: elongation without rupture	Grade II: (medium): partial rupture	Grade III (severe): total rupture of at least one beam
Initial cracking	+/-	+/-	+
Initial pain	Just the 1st hour	+	++
Walking	-/- box the 1st hour	Difficult support on the1st hour	Difficult or impossible support in unipodale
Swelling/inflaming	Moderate lateral	Antérolatéral Lésion cutanée	
Bruise	-	+/-	+ + (Lateral, then diffuses)
Passive Varus	Sensible	Painful	+
Anterior drawer	Painless	Sensible	+
Palpation of the LTFA or LLE	Sensitive, slight pain	Pain +	Pain ++

Table 1: Classification of sprain severity in 3 steps (questioning outcome, clinical) which must be confirmed by imaging.

Physical treatment of sprain after diagnosis

General principle of physiotherapeutics

The proposed treatment, after diagnosing the severity of the sprain, should not be unequivocal, or universal (Depending on the age, the robustness of the injured person and the severity of the injury, professional or sporting imperatives or even table 1).

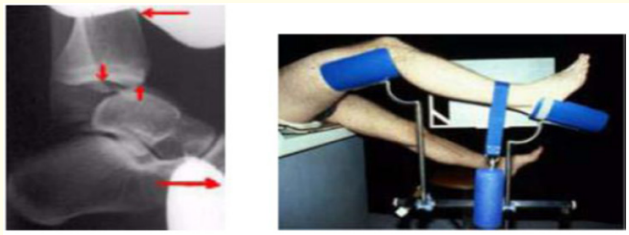

Figure 10: Search for an earlier drawer.

Treatment of mild, moderate and severe sprains and strains

Mild sprain: It is systematically functional and requires the initiation of the GREC Protocol from the first moments of the injury or shock. And physiotherapy must be introduced early just after the diagnosis of benign severity. Soft restraints can be performed for 10 days, generally the resumption of light training is done at D15.

Medium severity sprain: it can be treated orthopedically with the wearing of a resin boot or removable material adapted to the ankle, or functionally. Functional treatment is currently the gold standard, which involves the use of a removable splint (See Figure 11A) combined with relative relief for the first 10 days; resumption of sport is done at D45 under cover of a soft restraint.

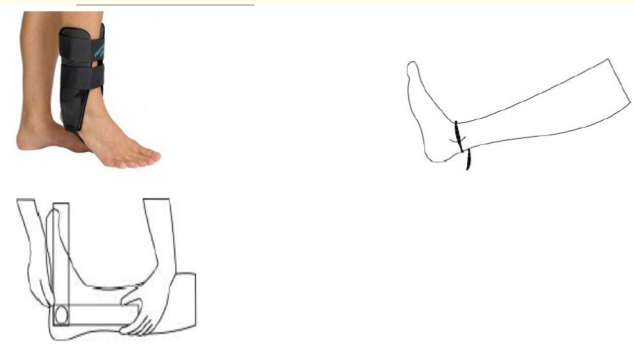

Figure 11: A: Example of a semi-rigid removable splint. B: Centimeter measurement of the malleolar perimeter and see the density of the edema and C: Tool for measuring ankle mobility, always compare to the healthy side in discharge.

Severe sprains: there are several therapeutic possibilities for these severe sprains, each with advantages and disadvantages (see table 3: different types of treatment for severe sprains). Functional and orthopedic treatments do not allow for the management of associated injuries.

Specificity of ankle sprain rehabilitation

Regardless of the degree of severity of the sprain, rehabilitation has two intrinsic components.

The first is the initial assessment of the ankle (Diagnostic Physical Therapy Assessment, BDK) which enables the most appropriate techniques to be chosen during the first sessions, followed by regular assessments which will guide future techniques according to the specific evolution of each patient. This BDK is based on the following criteria:

- Spontaneous pain, but also during walking or during activities or attempts at functional manipulation
- The extent of joint effusion of the hematoma and periarticular edema (if present)
- Static and dynamic morpho aspects of the foot, measurement of edema, centimetric measurement of the malleolar perimeter (see Figure 11B) and a comparison with the healthy foot. Measuring mobility and quantifying limitations by controlling the biomechanical and kinetic amplitude of the ankle and movement of the talus (see figure 11C: joint measurement tool).
- Mobility of the Talo crural joint, subtalar joint, Chopart's and Lisfranc's joints
- Articular laxity (drawer and shock of the talus, laxity of the subtalar)
- The muscular strength of the periarticular muscles, with emphasis on the muscles involved in the bimalleolar clamp (long and short fibular, posterior tibial).
- Functional instability under load during typical tests, in daily activities (walking, climbing rehabilitation stairs, measurement of the different kinematic phases of walking, especially the support time of the injured foot).

The second is the application of physiotherapic/physiotherapy techniques which aim to treat the sprain according to the dominance deduced from the evaluation carried out at each session.

We propose some essential elements of the rehabilitation of mild and moderate sprains practiced in our neuroloco-motor and osteoarticular rehabilitation service of the CHU Henri-Mondor, which are not exhaustive. Each physiotherapist can adapt it in his own way, according to his patient and his clinic.

Physiotherapy protocol for mild sprains and strains

Initial phase

- Begin with a therapeutic education: explain and teach the patient the GREC Protocol, so that the patient, once at home after the lesion, continues the 4 basic rules of the GREC/RICE Protocol. Splint: Removable anti varus orthesis. Then alternating baths (hot/cold), declining position at night and declining cure during the day, electrotherapy, low frequency especially on the adjacent muscles (soleus, gastrocnemius tibia, Achilles tendon) in order to avoid amyotrophy which is often very early by the phenomenon of underuse.
- Soft mobilization without excessive traction (flexion/extension without varus/valgus).
- Drainage of oedema; Proprioceptive work in discharge; Pain-free rule.
- In an evolutionary way: deep transverse massage from D2 or D3; ultrasound therapy from D4 to D5.
- Mobilization and articular normalization towards eversion of the lateral paddle of the foot and the talocrural (from D7).
- Neuromuscular mobilization (from D10 onwards); solicitation of the spurs and fibulars in analytic, then eccentric during functional activities.
- Partial-load neuromuscular rehabilitation, in bipodal and then unipodal mode on firm and flexible ground, with emphasis on closing the eyes in order to stimulate the ankle's proprioceptive receptors (cf. figure 12A and 12B).

Box 8: Physiological management after the 3-day algal phase

- - Initiate rehabilitation as early as possible
- - Continuation of mobilization in self-rehabilitation
- - Strengthening of fibular muscles+++
- - First in static, then concentric
- - Then interest of eccentric rehabilitation+++ then Freeman's plateau

Box 8

Physiotherapy protocol for mild sprains

- The initiative phase, and therapeutic education is the same as in the benign phase.
- Analgesic, cutaneous, trophic and circulatory physiotherapy.
- Require the partial discharge of the patient under cover of two canes (for at least the first 7 days after the injury), teach the patient how to use it.
- 48-hour compression bandage (see figure 12A), placement of a posterior splint during the first few days, placement of a semi-rigid splint (see figure 12B) allowing function during D7 to D30.
- Manual lymphatic drainage, pressotherapy, deep transverse massage after D30 on persistent ligament pain points.
- Mobilization and articular normalization towards eversion of the lateral paddle of the foot and the talocrural (from D28).
- Neuromuscular mobilization (from J 28); solicitation of spurs and fibulars in analytic, then eccentric during functional activities.
- Partial-load neuromuscular rehabilitation, bipodal then unipodal on firm and flexible ground, with emphasis on eye closure, sensory and sensory afference (cf. figure 13A-13C).
- Isometric contraction of the thigh, leg and foot muscles, contraction of the bimalleolar clamp muscles. Plantar cutaneous stimuli associated with the use of eversion muscles.
- Neuromuscular re-education in partial load, in bipodal, then gradually in unipodal, then eyes closed, in order to wake up and bring into play the receptors and integrate the musculo-articular effectors and involve sensitive and sensory information (at D45).
- Solicitation of spurs and fibulars in analytical and then eccentric during exercises and functional activities.
- 8-week proprioceptive self-rehabilitation program at home, in addition to the classic rehabilitation +++ with unstable board or shoe (see figure 13A-13C).

Figure 12: A and B: soft (A) and semi-rigid (B) Bandage.

Rehabilitation protocol for a serious sprained ankle operated on (by invasive or non-invasive surgery).

The limitation of our patients, engraved sprain operated must also have a protocol, which should not be neglected however.

The objectives in this framework will be to:

- Educate the patient to the different life hygiene advices, obtain a crutch without support as well as the anatomy in the activities of daily life, carry out a progressive resumption of support at D21, maintain the musculature of the injured lower limb, carry out a re-training to the global effort.

- The principle will be to respect the phase of no pain, no support for 21 days or even 28 days. Monitor the absence of complications; compression under plaster, skin lesion, phlebitis, complex regional pain syndrome.

The techniques

- Therapeutic education: explain and teach the patient how to put the mattress in a nocturnal position by interposing a cousin between the mattress and the box spring. Daytime tilting as soon as possible by 15 to 30 minute cures.

- Monitoring for signs of compression under plaster (edema of the toes, tingling, cold toes, Charcot's foot) and what to do, knowing that amyotrophy begins as soon as the first night of compression plaster is applied.

- Daytime declines should be regular 15 min every one or two hours, slight contractions under plaster are encouraged, to train the underlying and adjacent muscles and joints. Take anti-edematous anti-oedematous agents.

- Maintenance of the lower limb joints with emphasis on hip extension and knee extension. Passive mobilization of the interphalangeal and metatarsophalangeal joints.

- Neuromuscular musculature: contraction of the hip, thigh, leg and foot muscles against resistance opposite the toes. Special emphasis should be placed on the maintenance of the lateral hip stabilizers with resistance of one sixth of the body weight opposite the lateral condyle. Cocontraction of the leg muscles: flexion of the toes associated with dorsal flexion of the talo crural or/and dorsal flexion of the toes associated with plantar flexion of the sural triceps.

- From D21 onwards, functional work must be initiated: immediate learning of the simulated step and the ascent and descent of stairs. Evolutive resumption of support after D21 (depending on each patient, there is no universal rule, always take into account the clinic and the feeling of each patient) with plaster shoes, re-training for effort in discharge then in charge after D21 (cycloergometer, stepper, etc.).

- During the consolidation phase, and removal of the cast: immediately consider a semi-rigid splint (because always remember to compensate for the weaning of the resigne removal for a while) mobilize the gliding planes of all the periarticular soft tissues of the ankle and the scar, encourage the stimulation of the plantar skin supports and the development of the foot during the contact step. Caution, do not attempt to correct lameness immediately, as this remains a means of psychological defence for the patient during the first hours and days after removal.

- Sensitize the patient to the self-education exercises, showing him what to do and have him repeat it in front of you over and over again to make sure that the biomechanics learned are perfectly respected. As the days progress, continue joint gains by insisting on the recovery of dorsal flexion, abduction and eversion. Begin the proprioceptive work by targeting the vigilance of fibular and common extensor, the respect of no pain is an Absolut rule. Withdrawal of walking aids must be gradual.

- Delay joint gain in plantar flexion, adduction and supination and avoid combined traumatic inversion movement.

- Transcutaneous electric stimulation with very low frequency analgesic aim, manual or vacuum scar massage, ultrasound and pulsed emission in front of the scar and adhesions; deep transverse massage on painful ligaments, manual lymphatic drainage, pressotherapy, circulatory massage, alternating hot/cold bath. Massage and mobilization of all periarticular soft tissues with emphasis on the often impacted retro malleolar gutters, calcaneal tendon, anterior tarsal annular ligament.

- Gentle posture towards the dorsal flexion of the Talo crurale, contract-release on the sural triceps, isometry-isotonia. Analytical, concentric and eccentric muscular work of all the periarticular muscles. In evolution, we will start the muscular work in load, a work must really be done in unipodal on flexible plan, then unstable plan to wake up and highlight the neurosensitive and neuromuscular receptors, and rebuild a psychological confidence of the patient.

- **Box 9: Medical treatments**
- **- There is 1 micro-bleeding and local inflammation following the lesion, rupture (partial or total) of the ligament, followed by an inflammatory reaction (normal) with an edema that will take place and a local release of all the cytokines, free radicals. All these microbiologies will guide a slightly more systemic and self-defensive reaction at the site of injury (for our sake), this inflammatory period usually lasts 3 days, it is advisable to :**
- **- Do not give steroidal anti-inflammatory drugs, nor infiltration.**
- **- Avoid as much as possible anti-inflammatory drugs in all their generality, as well as their galenic form, so as to respect this inflammatory phase which constitutes the first stage of self-healing, also called muscular plasticity, a self-organization of soft tissues.**
- **- The principle here is to keep the natural thinking of the human body that will allow the healing, if we do the infiltrations of corticoid or NSAIDs, then we will inhibit this inflammatory phase which is of good war and necessary for healing. The GREC/RICE protocol, scrupulously applied, is able to cover the pain of the first decisive days for the** bases d'auto-cicatrisassions.

Box 9

The generality on the techniques of gain of mobility, muscular recruitment, stability: The techniques of gain of mobility (active and passive mobilization, specific mobilization, postures, contract-release techniques and stretching techniques) are used as soon as the pain allows it. In the first few days, varus amplitudes are not sought. They are used as long as the mobility is not identical to the healthy side, especially dorsal flexion. Some of these techniques can be used later by the patient before carrying out a sports activity.

Muscle recruitment techniques

These techniques have the sole purpose of preparing neuromuscular reprogramming. Techniques to improve stability (neuromuscular reprogramming) [10,11]. Feelings of release, instability or recurrence may appear after a sprain. Neuromuscular reprogramming (NMR) consists of placing the patient in positions of imbalance using various unstable tools in order to solicit the body's defensive reactions. This technique allows early resumption of activity, improves stability and reduces recurrences. Load MNR should be used as early as possible depending on the joint's indolence. In case of aggravation, the patient is readmitted to the prescribing physician.

Rhythm, number and duration of sessions: The duration and rhythm of the sessions depend on the evolution of the assessment indicators and the objective of the injured person (for professional sportsmen and women, a rapid recovery is sometimes required, but everything still depends on the type of sprain, see figure 14). The pace of the sessions should ensure a return to socio-professional activities as early as possible [9-11].

When to stop re-education

Chronological evaluation of the monitoring indicators (pain, oedema, mobility, strength, functional stability, activities of daily living) enables a decision to be made to stop the rehabilitation treatment according to the objectives previously defined jointly with the prescriber, the physiotherapist and the patient. These objectives must take into account the patient's specific activities (social, professional or sports).

	Breaking a beam 21-day splint (day)	Total rupture of a beam 21-day splint (nocturnal and daytime). J30-J45 (day)	Breaking 2 beams Splint 4 (days (nocturnal and daytime)
Rehabilitation/ Rehabilitation	+++	+++	+++
Reathletization/ sport recovery	3 weeks	From 30 to 45 days	From 2 months and 3 months

Table 2: Prediction table for functional treatment and return to sport.

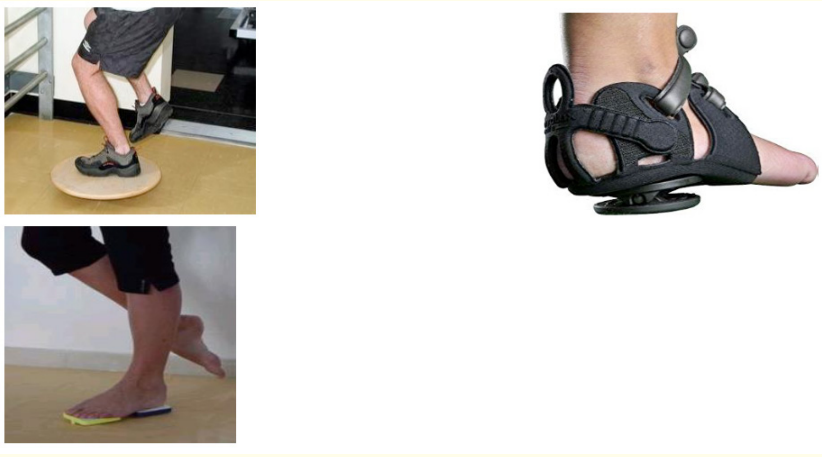

Figure 13: A, B and C: Equipment for self-rehabilitation on an unstable plane, involving neurosensory-motor receptors.

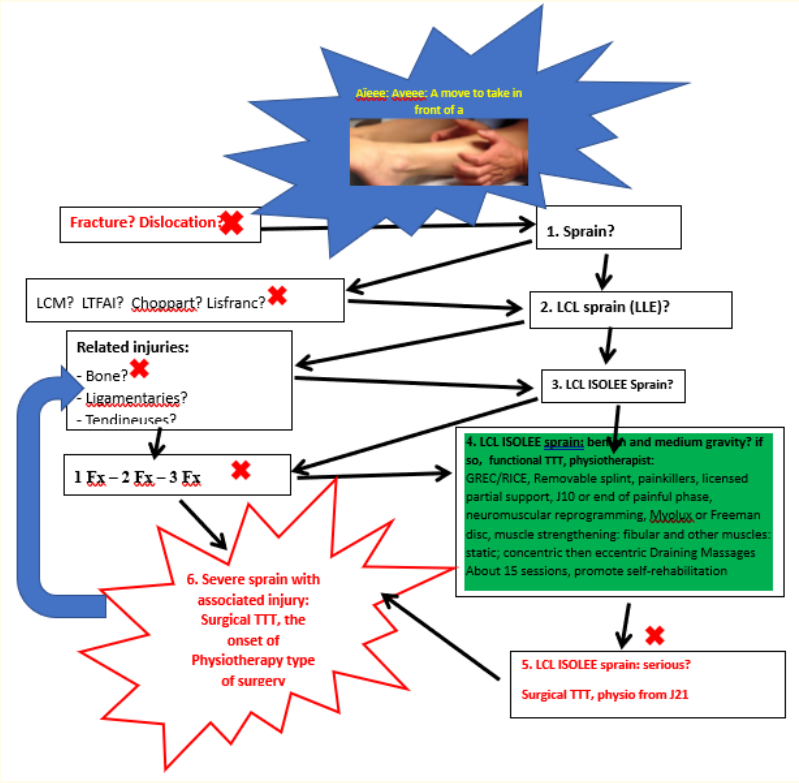

Figure 14: Physiotherapic management by diagnostic elimination; the procedure to follow after a dodge procedure would be to find out whether it is a fracture or a dislocation, if not, is it a sprain? if yes, which ligament is damaged, LCM, LTFAI, CHOPPART, Lisfranc? if not, is it an LCL injury? if yes, is it associated with a bone lesion? if no, how many bundles are affected (1 Fx, 2 Fx, 3 Fx?) if yes, then it is a serious sprain, and the recommended treatment is surgical, the physiotherapy itself would intervene depending on the progress of consolidation of the associated lesions. If, on the other hand, in point 3, no lesion is associated, whether it is a benign or a moderate lesion, then the treatment remains typically functional (physiotherapy). If it is severe without associated lesion, a surgical or functional treatment can be proposed, depending on the age of the subject, co-morbidities, and the profession of the latter (professional sportsman, amateur, etc.).

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