

Players' Rehabilitation and Reeducation Between Electro Stimulation Methods and Classical Work

Abstract

Numbers of athletes keep on playing despite a tendinitis and, as a result, the injury quickly becomes more serious and may even evolve into a chronic tendinopathy.

These reasons explain why the technical staff should be very attentive and not hesitate to put the athlete to rest in order to avoid the appearance of tendinopathies. The medical staff generally asks for an ultrasound scan to be able to observe the peritendinous effusion. The athlete, in some cases, needs surgery which success is guaranteed but the reeducation is lengthy. The medical staff should implement a precise program, the reeducation should be specific and minutely followed, and the fitness trainer will work closely with the athlete to allow him to regain all his high level capacities and qualities. One speaks of rehabilitation period during which the medical staff and the fitness trainer should collaborate to analyze the player's evolution and decide whether he should resume collective training. A bad reeducation and rehabilitation will lead to a risk of an omnipresent relapse.

Key words: Rehabilitation, Reeducation, Electro Stimulation, Physiotherapist, Electrode, Proprioception

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Résumé

Beaucoup de sportifs continuent à jouer malgré la présence d'une tendinite et, de ce fait, la gravité de la blessure s'amplifie rapidement et peut même devenir une tendinopathie chronique.

Ces raisons expliquent pourquoi le staff technique doit être très attentif et n'hésite pas à mettre au repos le sportif afin d'éviter l'apparition de tendinopathies et exige une échographie afin d'observer l'épanchement péri tendineux. Dans certains cas, le sportif devra subir une intervention chirurgicale et une rééducation spécifique et minutieusement suivie par le préparateur physique afin de permettre au joueur de retrouver sa condition physique ainsi on parle de période de ré-athlétisation durant laquelle le staff médical

Introduction

Reeducation is a very important step and, as such, an early care in a reeducation center from the third post operative day is necessary to be able to immobilize immediately the knee and insure the post operative follow up, the prevention of tromboembolism, pain care, healing and, at the end of this period, a reeducation protocol is established which could last up until six months. It is based on a without restraint solicitation of the transplant, an early

et le préparateur physique doivent collaborer afin d'analyser l'évolution du joueur et de décider ou non de sa reprise lors de l'entraînement collectif. Une mauvaise rééducation et ré-athlétisation du joueur blessé peut entraîner un risque de rechute omniprésent.

Mots-clés : Ré-athlétisation-Rééducation-Électrostimulation- Kinésithérapeute - Électrode - Proprioception

knee mobilization, an adapted muscle building allowing the resumption of an athletic practice without limitations, muscular isokinetic evaluations after à three-six-twelve post operative months (Cascua, 2001).

Muscular capital is essential in the prevention of serious knee strain especially in the muscular equilibrium.

Indeed, in case of a muscular disequilibrium in favor of the quadriceps and, during the launched and forced movements, all the mechanic constraints risk to be undergone by the anterior cruciate ligament which will lead to its rupture. Indeed, the hamstring will not be able to play its braking role. We will be able to consider a well targeted functional reeducation in order to rebalance this ratio in a pre-emptive goal. A well conducted functional reeducation work seems to be a preventive element of a central pivot lesion.

What are the benefits of rehabilitation exercises?

The work of a fitness coach consists on reducing to a minimum the number of injuries in a given season through a prevention work and a good management of work loads because each injury needs an analysis of causes and context. Likewise, exams and medical discussion should be undertaken to diagnose exactly the pathology and therefore deduct a working time for the reeducation to set up .Regardless of the injury, we observe two periods: reeducation (strictly reserved to the medical staff) and rehabilitation (which is under the physical trainer responsibility collaborating with the medical staff) (Rahnama et al, 2008).

These two stages before resuming collective training are very important; the athlete should regain the entirety of his physical capacities (joint stability, no muscular deficiency, avoiding compensations that could lead to a new injury).The work should be targeted and rigorous and one should always keep an eye on the athlete when he resumes training

1. Analysis and reeducation

It is the basis of the medical treatment using techniques with analgesic goals and rebalancing techniques. We will study, for this matter, the knee injury in football.

1.1. Cruciate ligament rupture

The cruciate ligament rupture is a serious sprain with rupture of the cord and severance of some blood vessels leading to haemarthrosis and hematoma then a bruise. The knee is a complex joint in which different ligaments are present: lateral, posterior and anterior. It is the posterior cruciate ligament that is most of the time affected during the famous rupture of the cruciate ligament. In case of immobilization, these anterior cruciate ligaments do not heal after a rupture which in most case and contrary to other ligaments that do heal. Following this rupture, the medical staff will recommend two alternatives to the athlete: either an immediate reeducation or a surgical procedure .In

the professional world, medical staffs generally choose surgery (Ghozlane et al, 2006) (Unless the player is at the end of his career or at the end of his contract in which case he may oppose the operation).

In case of a surgery, the player will be operated in a few days. There are different kinds of operations, the most common consist of taking a small central part of the patellar tendon and replace with it the posterior cruciate ligament (or the anterior cruciate ligament).Before surgery , some physicians advocate a reinforcement work of the stabilizing muscles. After surgery (atrophy), reeducation is very precise and could begin from the second day using electrotherapy in order to conserve a muscular tone at the immobilized zones level (Lamarque, 2004).

1.2. Knee sprain (anatomy and biomechanics)

The sprain is defined as an injury of a ligamentous structure. The knee sprain is still a football common pathology which could come in different shades of seriousness from the benign sprain of the tibial collateral ligament to the rupture of the anterior cruciate ligament. The knee's articulation is provided by passive elements (essentially the ligaments) and active elements: the muscles. In an intra-articular situation, the posterior and anterior cruciate ligaments form the central linchpin insuring the anterior posterior and rotary of the knee. One finds also the meniscus which stabilize laterally the knee acting as wedges in a extra-articular situation .They are the tibial collateral ligament (TCL) and fibular (FCL) and also the fascia lata strip (FLS) (Pintus et al., 2007).

All ligaments could be affected during football practice. We, nevertheless, notice the bigger frequency of occurrence in the TLC and ACL injuries compared to the relative scarcity in the LCF and especially in the LCP injuries (Hägglund M et. al ,2006).

- The treatment will directly depend on the ligaments that are affected .If it is the LLE and /or LLI that have been broken, the player will not necessarily be operated, he could directly start reeducation with six weeks of immobilization, plastered, with an anti inflammatory (to avoid a worsening of the inflammation), a drainage, massages to lessen the swelling (resorb the hematoma) and the pain. The reeducation proper could then start, the player will have sessions of muscular rebalancing , sessions of proprioception work, sessions related to equilibrium and an isokinetic analysis and ,at the end, the rehabilitation will start with a reeducation work.

- The complementary LCP and LCA treatment does not inevitably necessitate an immobilization, it is essential only in case of a surgical operation followed by reeducation and rehabilitation (Murphy, 2002).

2. Reeducation and readjustment post chirurgical intervention

- Immobilization to avoid lateral constraints
- Fighting pain - cryotherapy –stop inflammation (avoiding its worsening)
- Electrotherapy (atrophy before operation and some days after in order to keep a tone at the immobilized muscles level.
- Mobility work of the knee in the axis and in flexion.

- Cardio-vascular work on arm ergocycle and on amplitude of the knee movement.
- Bodybuilding of the muscle to loosen the ligament (the weight is positioned near the patellar tendon and building of the knee stabilizers).

3. Electrosimulation in the athlete's training

It is a method of training and reeducation complementary to the practice of a physical activity and to the therapist's exercises. It is performed by exciting neurons and recent technological progress and the scientific approach to training have dramatically changed the perspective one had about the muscular electro stimulation (MES). Thanks to considerable scientific and technological advances, MES is today more and more present in sport but this method is also used by physiotherapists in reeducation, sport preparation (MES) and is used successfully in medical readjustment to healthy athletes to improve their muscular strength to the maximum (Cometti, 1988) and also as a training support in all sports at all levels. It is essential in order to use electro stimulation in athlete training to know the theory and practice of traditional bodybuilding because this method obeys to the same rules especially regarding the quality of the necessary work.

3.1. The electrodes

Electro simulation is based on the same principle with the difference that electric impulses are transmitted through the skin by way of electrodes. There seem that electrodes in flexible elastomer give the best results, they are laid with a contact gel. One uses different shapes positive and negative electrodes for a way, and the evolution of the electrodes characteristics is, partly, responsible for the technic progress. Despite that, it does not present any difficulty because the muscle receives information as an electric current that must circulate in the way of the muscular fibers (Viani, 1987). We should therefore place the electrodes in the way the muscle works and the muscle should stimulate its motor point to be efficient.

3.2. The stimulation technical characteristics

It is in isometric situation against resistance that stimulation is realized. If realized by electro stimulation against a fixed resistance (isometry) or mobile (concentric) and due to the fact that materially the isometry solution is the most simple to implement, it has been chosen. It has been demonstrated that the results would be better when the muscle is stimulated in a rather shortened position but never in a position of complete shortening which is the ideal work position for the quadriceps. (Portman, 1988)

The different brands used by professional teams such as *Cefar* or *Compex* are defined by the combination of many parameters: the current type, the impulse width and the intensity that are going to act at the spatial recruitment level. The characteristics should be as follow: a perfectly symmetric and comfortable current, a maximal resistance (1500 ohms), no risk of burns whatsoever, medical norm, intensity (0 to 210mA), and frequency (1 to 100 Hz).

3.3. Electrosimulation benefit in high level training

Electro simulation training cannot be considered as a form of doping. Actual bodybuilding methods and in particular eccentric work and some situation of box jumps (generally called plyometric training) require a maximal solicitation and even supra maximal of the muscular groups involved in the formation. It is for these reasons that electro simulation has been introduced in training in order to know if it could be an interesting and efficient alternative to classical work (Martin et al, 1991).

The first experimental investigations confirm its efficiency without showing superior results compared to traditional methods .Nevertheless, electro simulation seems to present some benefits that makes it an interesting and non insubstantial additional for high level athletes. Amongst the benefits it seems to present, we can cite an efficient action on the muscular mass, on the maximal concentric strength, on the isometric strength and especially the eccentric strength. In a number of sports, the method has been shown to be effective (Duchateau, 1993)

Electro simulation allows an approach on the training level, on the recovery level, on the pain relief and on the rehabilitation level by implementing programs with exitomtric or analgesic aims .Most teams use and benefit from electro simulation in high level foot ball teams for:

- a training supplement
- a mean to relieve pain
- a mean to gain strength in training
- a rehabilitation complement
- a mean to recover

3.4. Maximum strength developed under electro stimulation

For bodybuilding with charge, the development of strength depends on the contraction intensity. It is obvious that one could obtain progress in electro simulation if induced strength is inferior to 60% of the maximal voluntary strength. Most of the attempts undertaken with electro simulation with high level athletes do not measure the induced strength during training. We have noticed that individual variations are important: some players can barely develop 10% of their maximal voluntary strength while others reach easily 90 %.The first condition to satisfy to work correctly in electro simulation is therefore to control the strength produced through a dynamometer or better through a device "cybex" or "biodex" allowing a very precise control of the strength .Taking these precautions , with an ECL sport device, we obtained an average of 79 % of the maximal voluntary strength (MVS) (Enoka, 1988).The maximal induced strength parameter is essential in the training control and experimentation of the muscular stimulation work. The improvement in athletes is real on numerous muscular groups; results are nevertheless extremely variable according to the muscular groups and stimulators used.

The maximal strength programs that improve the capacity of maximal strength and also the muscular mass without the risks associated with handling of heavy charges in

bodybuilding for the foot ball player are perhaps interesting for the leg's muscular group (quadriceps or hamstring) to increase the player's strength, ball's strike quality and especially to limit the risk of injury in particular at the hamstring level which is origin of a number of muscular lesions (spasm, strained muscle , torn muscle)

The change of the maximal eccentric strength that has been considered by Schmidt Bleicher (1985) as the athlete's absolute strength represents certainly one of the essential features of this method. Electro stimulation advances the athlete on the strength's parameters which bring a more durable improvement and transferable in the strength's diverse expressions (Cometti, 1991).

4.The role of physiotherapy

In physiotherapy, medical care is a real strategy and objectives are various: disappearance of the edema, muscular strength's recovery of range of motion, supports control; all this should allow the come back on the fields. To attain these goals, there are multiple means: manual techniques obviously massage articular mobilizations but also physiotherapy, muscular strengthening, proprioceptive work.

4.1.Amplitude gain techniques

They depend, of course, on the pathology treated and therefore of the limitation's origin. To soften a cutaneous, subcutaneous or muscular scar is participating to the amplitude gain, raise a contracture through a deep massage or a heat application is participating also. One could count on an oedema drain, on an articular mobilization (osteopathic techniques) to gain some degrees. The muscle energy technic (of contracted-released) using the inversed myotatic reflex is, from this point of view, very interesting and the big principles are to respect the movement physiological plans and axis, to mobilize in the authorized maximal amplitude by the treated pathology and especially respecting the pain in order not to reactivate painful phenomenon (Geoffroy, 2004). It is indeed very penalizing for an athlete to be obliged to resume his activity despite an amplitude limitation.

4.2.The mobilization objectives

- ✓ on the nervous system: stimulation of receptors of proprioceptive sensitivity (articular, musculotendinous)
- ✓ on the muscular tissue: improvement of the extensibility and elasticity, work on the sliding plans between bones, muscles, aponeurosis and the intermuscular partition, bursa
- ✓ on the articulation: tensioning of the articular capsule.
- ✓ on the skin: tensile stress of the scarring plans
- ✓ on the circulatory function: easing of the venous return (Rochcongar et al , 2004).

5.Reeducation and rehabilitation methods in foot ball

There are many rehabilitation and reeducation techniques in the athlete world. Besides the integrated physical exercises cited above, these techniques are implemented by the fitness trainer and the medical staff. These new techniques allow

the speeding up of the scarring process and recovery such as blood spinning .This technique involves making the tissues bath in an emulsion made of calcium and a plasma rich in minerals, hormones, vitamins and chips. This emulsion is from the athlete himself through a blood collection natural autologous (Hamilton, 2008).It could be used either during a surgical operation or during a muscular injury by way of an injection. Medical staffs in foot ball are starting to use it to obtain more rapid results.

5.1.Proprioception

An example of development of neuromuscular qualities for equilibrium, proprioception is an efficient tool for preventing articular and ligament injuries. The learning progress is based on discharge exercises, semi-charges and then on charges .The athlete works on instable trays or a trampoline, on a *Bossu* , a *Waff* , a pillow , a balance mat with or without visual control. This work should, ideally, be done in situation on the field and it should be steady to prevent numerous injuries.

The muscular static reinforcement work with charge and to increase the muscular active stiffness and the dynamic reinforcement work are the eccentric work and plyometry that increase, among other things, the active muscular stiffness but also facilitating the myotatic loop. Any maladjustment of proprioception will lead sooner or later to muscular, articular or even bone lesions (Gillot and Peltier, 2004)

To work on one's equilibrium, avoid injuries or in reeducation period, proprioception plays an important role to improve equilibrium, effective motor coordination and therefore reduce the risk of injuries and muscular strength (joint reinforcement). A good knowledge of harmful moves is necessary, supports should be perfectly mastered and learning is therefore realized on stable and unstable plans, indoor and outdoor, booting is adapted to the play condition: it is the proprioception work that incorporate also all the other risky moves (Jean, 2008).The fitness trainer will then continue to undertake a specific support work indoor or indoor (in the axis, sideways then combined) and muscular dynamic reinforcement exercises of the inferior members and the whole muscular chain. These elements are essential to the recovery of the muscular and articular functions. One could also work with the *physio ball* a tool very frequently used in reeducation, it enables a proprioception work, a muscular reinforcement and relaxation and stretching. It could also be used in different manners according to different objectives with exercises associated to the traditional bodybuilding movements that match the four body parts: upper body, lower body, abdominal and lumbar belt and equilibrium.

5.2.Muscular reinforcement

Strength is a quality that still makes refractory. Strength has always been worked under different forms of general reinforcement but very seldom with charges while all contraction modes could be used in reeducation.

The isometric mode consists on maintaining the same level of elongation which is largely used in the first reeducation periods (immediate post operative, during immobilization in inferior member splint).In reeducation, it is useful for the fight against amyotrophy and even contribute to the amplitude gain work (work in

contraction quadriceps). If it is not a purpose it is nevertheless an important stage but only in the first reeducation times (Dufour, Pilu, 2005).

The muscular concentric reinforcement work in the healthy subject is less used in the eccentric mode being the reason of lesions. It is beneficial in soliciting different driving units and to be non-traumatic. In opposite to the eccentric work in reeducation, it contributes to the amyotrophy recuperation ideally realized on an iso-cinetic device (shortening at a steady speed) (Philippe, 2006). It is, however, a very useful tool during all throughout the reeducation. In relay of other contraction modes, it is particularly useful for the quadriceps work after ligament-plasty of knee or also at the end of reeducation after the eccentric work following a lesion of the right femoral.

Also in the strength training, another method is based on the use of the proprioceptive work in the active recuperation between repetition series. For example, after a squat sequence, envisage proprioceptive protocols to promote recuperation and maintaining the neuromuscular system always in action. Finally, work charge should be adapted taking into account the necessary alternation between work and rest cycles. Even so, the ideal work charge definition is very difficult and is different from a sport to another and from an athlete to another.

	Impulse	Frequency	Climb	TC	Descent	Rest	Duration
Explosive	50-100µs	70Hz	1 ms	3 ms	1 ms	20 s	10 min
Endurance	0,2-0,4ms	70Hz	5 ms	15 ms	3 ms	2 min	45 min

Table: Parameters of moderated alternative medium frequency currents

5.3. Benefits in developing strength in foot ball

During foot ball games, players constantly perform changes in directions. These sudden actions are directly linked to the muscular contraction strength. Regarding explosives actions, it has been related that the maximal strength was correlated to the performance in sprint and at the height of jump in high level football players (Wislof et al, 2004). As a consequence, strength acts directly or indirectly on the whole of the parameters of performance in foot ball where it presents a non negligible benefit and they are numerous:

- increase muscle elasticity
- improve stability of some articulations (knee)
- local muscular resistance
- prophylactic role (preventive treatment)
- increase the relaxation capacity
- better work charges tolerance
- bring an effort culture into the group
- improve the coordination intra and intermuscular

5.4. Aquatraining

It is a very frequent method in reeducation and allows to reinforce muscles on which one applies an important pressure. Indeed, in water body does weigh only 10%

of its weight on land and this only when immersion is up to the neck .In aquatic environment, the “skeleton-muscle” system does not support any charge while it creates a resistance twelve (12) times superior to that of air. To be immersed allows reconstituting similar efforts to those of bodybuilding movements.

Numerous studies have related that a running training in water may be the equivalent, or even higher, of those produced on land at the same level of intensity. Water induces a feeling of massage to muscles at every movement while allowing an improvement of the blood circulation and a muscle relaxation. Regarding the exercises proper, all exercises undertaken on land may be important but they stay specific to the activity, caloric expenditure is between 20 and 40 % superior to land exercises. Depending on water temperature, intensity and the type of exercise, the exercises should be undertaken with equipment such as water dumbbells, packets, boards while keeping a correct position because an incorrect position could lead to other lesions (Lamarque , 2009).

6.Relapse risk

Following an injury, medical staff should put in place a precise program; rehabilitation should be specific and followed meticulously. The fitness trainer will also work closely with the player in order to allow him to regain all his capacities and high level qualities. Rehabilitation is still a period of risk of relapse, the benefits of validating recovery criteria and the fact of following daily the athlete allows diminishing them. Nevertheless, no matter what one does, these risks of recidivism are never null.

Most of relapses would be related muscular injuries and sprains. It has been determined that 48 % of relapses were contractures, elongation or muscle tear and 19 % were sprains. The fitness trainer and the medical staff should establish a preventive program in order to reduce the risk of relapse (notably muscular problems).Regarding the tibial hamstring injuries, it has been proven that their reinforcement (through eccentric type of exercises) and at the rate of one to two weekly sessions during ten weeks would diminish the risk of relapse (Wood et al, 2009)

At the resumption, the player is encouraged to hit, maybe not to the goal, but surely for transverses. It is then important that this move is acquired before returning to the group. Thus, each pathology has its sensitive exercises that should be well mastered. One should estimate risks during shuttle and on line periodical exercises type 10-10 and 15-15 and 30-30 (Bisciotti et al, 2011).Then , the player should undertake exercises with direction changes, bodybuilding ,plyometry exercises and with ball according to the type of structure involved.

The last session represents the end of this rehabilitation. One does not doubt, after this latter, of the player capacities to regain its place in the group. This session should be the most traumatogenic possible based on a sequence of moves realized at high intensity. The return to the group obeys obviously to the other criteria, namely absence of functional signs and a normal clinical exam.

At the end, the field tests specific to foot ball and the majority of endurance tests are not specifically to be implemented in foot ball but the Buchheit Test is specific to

foot ball .It is an intermittent test and foot ball is an intermittent sport for example, the 30-15 Intermittent Fitness test (30-15 IFT) (Buchheit , 2015).This test shows the intermittent activity of the foot ball player during a game. It is relevant, validated and reproducible; it determines a speed V 30-15 IFT that will serve as a reference for an intermittent work. This test performance is significantly correlated to the explosive qualities of the inferior members which are very determinant for performance in collective sports.

Conclusion

Electro stimulation is a training method that athlete should take into account. It is a supplementary mean to vary training. In the spirit we have developed in the article for body building, it allows to do without other traditional means but is not a miracle method that would dispense from training or working to attain spectacular progress. Electro stimulation training is efficient and represents an interesting alternative compared to other methods .It could replace for some time the work with bars which is very interesting in disciplines necessitating numerous movements. One could also target the muscles to work and it tires the subject only locally which makes interesting in competition period to maintain strength. For the many players with back injuries and who could not work their legs with complex moves such as squat, it allows continuing electro stimulation which is efficient for warm up. It also allows fighting cramps off in discipline of collective support (foot ball)

But as all methods, electro stimulation if not adequately implemented could lead to drawbacks: a bad positioning of electrodes could lead to muscular disequilibrium; an abuse of work will lead to intense lumbago and a very important drop in performance. An exaggerated practice of electro stimulation could lead to a loss of gestural coordination. We therefore, advise to combine electro stimulation with classical work when possible.

No matter the country and the level of play, players tend to get injured more during games compared to training. In England, it has been shown that injuries occur 63 % during games and 34 % during training. For this, reeducation will depend on the tear's localization with tears located at the member's extremities being the most feared. During reeducation, the medical staff and the fitness trainer should be very precise. When it starts, it consists on specific sessions of rehabilitation and one should work specifically according to the activity. The classical work of rehabilitation should be progressive and its temporal organization specific and very precise: mobility work, proprioception, muscular reinforcement in defined contraction regime, support work, dynamic work....There are other means to undertake the player's rehabilitation and reeducation. It is up to the coach and the physician to target the player's needs to implement the good methods.

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