The effects of MLS laser therapy in élite football players affected by muscles injuries: a controlled clinical trial.

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ABSTRACT

Muscle injuries are frequent in élite football players, with a percentage of 30-40% of all injuries. The 22% of total injuries are muscular relapses. The focus of this study was to evaluate how the laser therapy could modify the recovery time in élite football player. The treatments have been performed with a Multiwave Locked System (MLS) laser. The sample group of football players was divided into two groups: the first group has been subjected to the standard rehabilitation program without MLS laser irradiation, the second group has been treated with the new rehabilitation program that included laser therapy.

We compared the average injury's duration in the two groups to establish the efficacy of the MLS laser treatment in accelerating rehabilitation. In spite of a positive trend observed in the laser-treated group, which showed a decrease of the recovery time on the basis of the lesions considered, the difference in comparison with the control group was not statistically significant, also due to the low number of patients considered.

Therefore, the results suggest that laser therapy could be useful to shorten the recovery time after muscle injury, but further studies with a larger number of cases are required to statistically demonstrate the efficacy of the MLS laser therapy.

INTRODUCTION

Soccer is actually the sport most performed in the world [1]. His popularity has lots of financial implications especially in élite soccer. Injuries have a greats influence on team's balance and management, both directly, due to the medical costs, and indirectly, due to a decrease in the team competitiveness caused by the absence of one or several football injured players1. So, each professional football team has increased the amount of medical staff and give them the right tools to optimise their work.

Muscle injuries are frequent in élite football players, with a percentage of 30-40% of all injuries [2,3]. The anatomical region most affected by injuries in soccer is the lower limb [2,3].

The 22% of totals injuries are muscular relapses [4]. These elements underline the importance of primary prevention to reduce incidence of muscular injuries and secondary prevention to reduce incidence of relapses [5,6].

Laser therapy is important to prevent and to treat muscles injuries. In fact, both in in vitro and in clinical studies laser therapy has given large evidence of usefulness to reduce pain [7,8] and inflammation [9,10], to promote reabsorption of oedema [10,11] and wound healing [12]. Moreover, when properly used, laser therapy is devoid of side effects.

However, in spite of a large diffusion of laser therapy, molecular and cellular mechanisms that underlie the observed therapeutic effects are not completely known. There are many studies but often results are conflicting and barely comparable due to the variety of effects and biological response, that depend on the type of laser emission, the operative conditions and biological tissue studied (different body's regions, different tissues, different kind of cells etc...). Frequently, conditions and parameters used in clinical studies cannot be compared with the ones used for in vitro studies. Moreover, laser therapy is at times administrated without a correct evaluation of laser parameters (wavelengths, power, frequency, etc...), status and characteristics of the patient.

The focus of this study is to evaluate how laser therapy could modify the recovery time in élite football players.

MATERIALS AND METHODS

The treatments have been performed with a Multiwave Locked System (MLS) laser (ASA Srl, Vicenza, Italy). It is a high power (average power up to 1.1 W, class IV) IR laser with two synchronized sources (laser diodes). The two modules have different wavelengths, peak power and emission mode. The first one is a pulsed laser diode, emitting at 905 nm, with peak optical power = 25 W; each pulse is composed of a pulse train (single pulse width = 100 ns, maximum frequency 90kHz), thus varying the average power delivered to the tissue. The frequency of the pulse trains may be varied in the range 1-2000 Hz. The second laser diode (808 nm) operates in continuous mode (power 1.1 W) or in pulsed mode (pulses repetition rate 1-2000 Hz), mean optical power output = 550mW, duty ratio 50% independently of the pulse repetition rate. The two propagation axes are coincident. MLS laser is a device already used for some years in clinics (FDA approved and CE certified instrument) and applied in particular in physical medicine and pain therapy.

We analysed muscular injuries of football players belonging to the A.C.F. Fiorentina youth team. We included in the study all the professional football players of the Team with age from 13 to 19 years, members of the categories Allievi Regionali, Allievi Nazionali and Primavera who have got diagnosis of muscle injury occurred in the period January 2010 - October 2012.
We excluded all Team's football players that used MLS laser therapy for other types of illness (tendinitis, sprain, low back pain, etc...).
We enrolled in the study 32 athletes and divided them in two groups: 18 athletes were treated with standard rehabilitation program (group 1) and 14 athletes were treated with the experimental rehabilitation program (group 2) which included the laser treatment.

Standard rehabilitation program (group 1)

The standard rehabilitation program for muscle injury used by A.C.F. Fiorentina football team consisted of:
- Gym muscular exercises, free body or isotonic machines, that allow the damaged muscle to work in different kinds of muscular contraction (isometric, concentric and eccentric). The muscular exercises should be done under pain threshold (Borg CR10 ≤ 3/10).
- Proprioceptive exercises like bouncer, skimmy and specific exercises on sand.

Organic exercises on cyclette, walking and running on tapis roulant or in soccer field.
- Free body coordinative exercises.
- Static, dynamic or hold-release stretching.
- Finally diat hermy treatment (TECAR®) in capacitive modality.

Experimental rehabilitation program (group 2)

The experimental rehabilitation program had the same contents of standard rehabilitation program with addition of MLS laser therapy. Lasertherapy has been applied as follows:
- For muscle strain (grade of lesion 1°, 1°-2°, 2° and 3°) we used the following parameters: 1500 Hz frequency, 50% of intensity, 10 min exposure, 253,6 J energy delivered by handpiece.
- For contusion and mild strain we used the following parameters: 700 Hz frequency, 50% of intensity, 10 min exposure, 198,3 energy delivered by handpiece.

Laser therapy was administered daily (5 days per week), starting 24-48 h from muscle injury. For treatment, laser was isolated by the other physical therapy's machines and it was staged in a closed little room. Laser therapy was administered in a dedicated room, by means of a scanning automatic arm. Athletes and physiotherapist wore specific protective glasses, provided by ASA srl.

The diagnosis of muscle injury was done by the medical staff of A.C.F. Fiorentina in two steps: immediately on soccer field, based on clinical symptoms reported by football players; then, 24-48 h after the event, muscle injury was confirmed by several clinical tests and diagnostic instrumental tests (Ultrasound or RMN). Immediately after diagnosis of muscle injury, athletes started the rehabilitation program.

The end of the rehabilitation program was fixed on the basis of clinical parameters, like absence of pain at percussion (VAS < 1/10), complete ROM without pain at joint where damaged muscle operates (VAS < 1/10), muscular strength 5/5 (Kendall scale), no pain during rehabilitation exercises (Borg CR 10 ≤ 0,5/10) and a positive psychological attitude of football players towards the return to competitions. Moreover, in many cases the medical staff made an ultrasound control to verify the complete healing of muscular damage.

At the end of the rehabilitative program, athletes started both training with team trainers and secondary prevention program with physiotherapists and trainers.
We analysed the recovery time of each injury, expressed in number of days from the beginnings to the end of rehabilitative program. We also analysed the way of injury (match or training), muscles interested by the lesion and severity of muscle injury.

RESULTS

Graph 1 reports the summary of the patients enrolled in the study. The medical diagnosis and rehabilitation program (group)are reported.

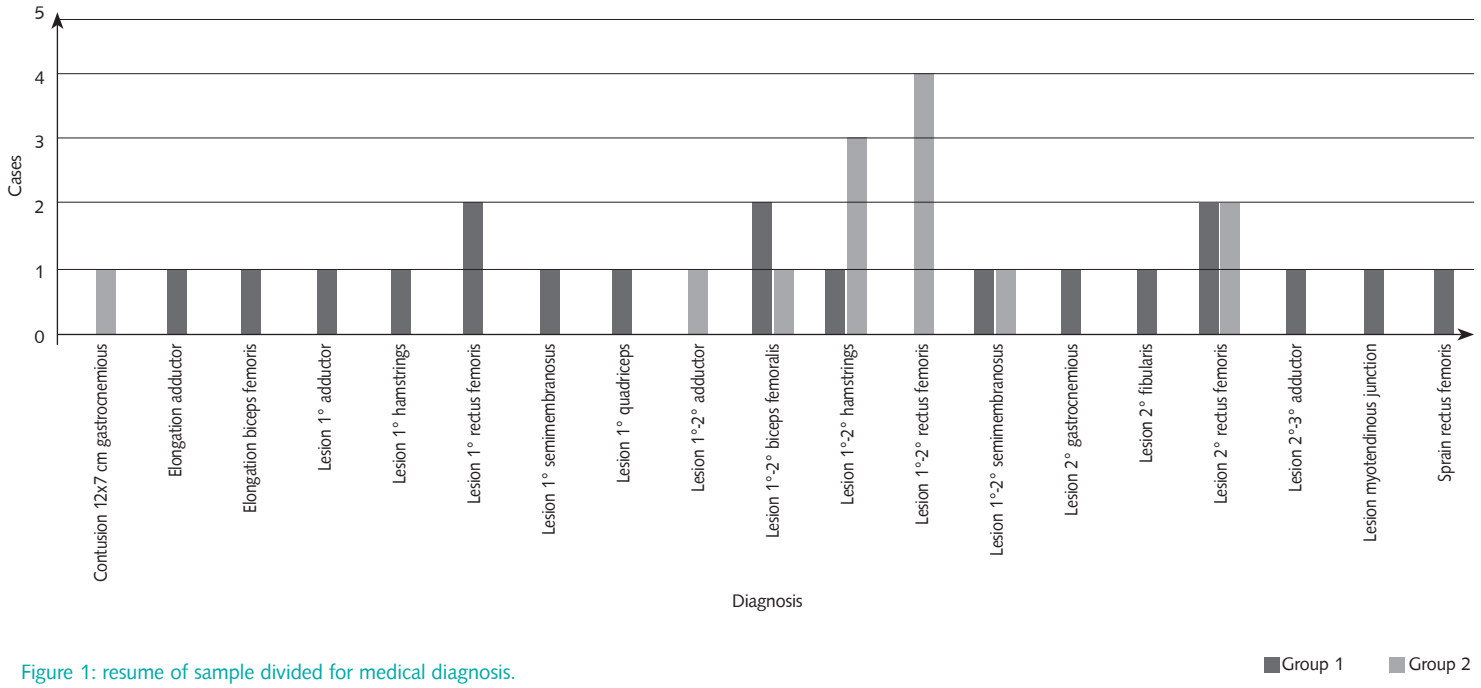

Figure 1: resume of sample divided for medical diagnosis.

Data show a difference in the average time recovery between group 1 and group 2. The group 1 average time recovery is 22,05 days, the group 2 average time recovery results 23,31 days (Graph 2). The difference between the two study groups is not statistically significant (p-value = 0,7085).

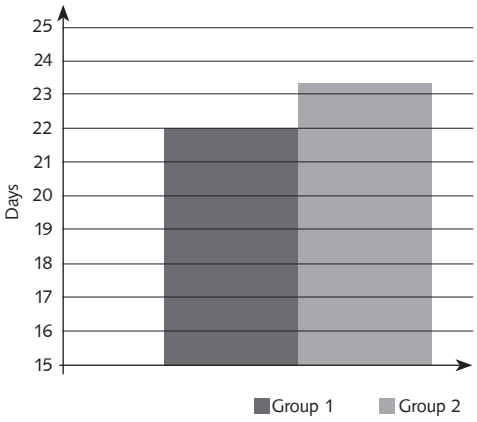

Figure 2: injuries' average duration

In order to analyze the data in detail, the patients were further divided into groups based on the kind of muscular injury and, for each group, the recovery time was calculated (Graph 3). Obviously, under this point of view, we studied only the groups whose patients were present in both the rehabilitation programs; therefore we considered only the groups "lesion 1°-2°" and "lesion 2°".

Into the group "lesion 1°-2°" data show a difference in the average recovery time between group 1 and group 2. The value for group 1 is 26 days, while for group 2 is 23,1 days (Graph 3). However, the difference between the two study groups (p-value = 0,5789)is not significant.

Also considering the group "lesion 2°", data show a difference in the average recovery time between group 1 and group 2. The group 1 average recovery time is 33 days, but drops to 29 days in the group 2 (Graph 3). The difference does not result statistically significant (p-value = 0,7763).

If we analyse the prevalence of muscle groups most affected by injuries, we can see that hamstrings are the most affected by lesions (41%), followed by quadriceps in 38% of cases, adductors 12%, gastrocnemius and soleus 6% and fibular muscles 3% (Graph 4).

The prevalence of injuries divided for type of lesions shows that lesions 1°-2°

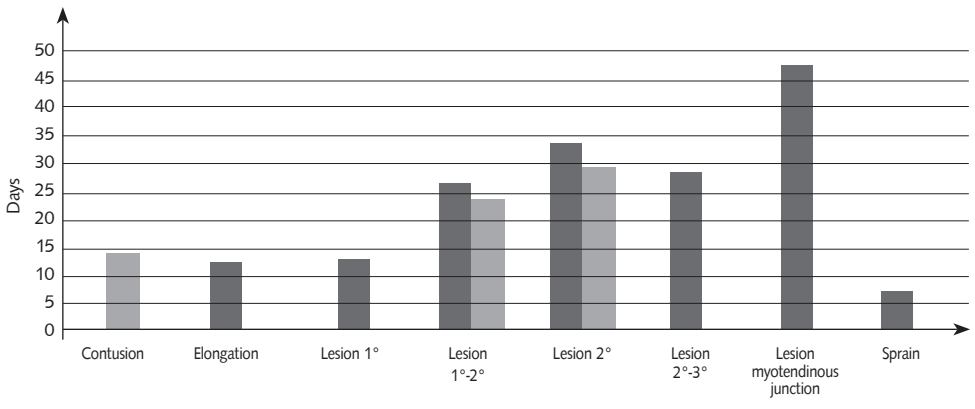

Figure 3: injuries' average duration divided for type of muscle damage

occurred in 44% of cases; followed by lesion 1° and lesion 2°, both observed in 19% of cases; 6% elongation; 3% contusion, mild strain and lesion 2°-3° and lesions of myotendinous junction (Graph 5).
Graph 6 reports the patients in relation to the month and practice performed (match or training) when the injury occurred.
Finally we analyzed the difference between number of injuries verified during training (28% of cases) and number of injuries verified in football matchs (72% of cases). There is a statistically significant difference between the two groups, $p < 0,01$ (Graph 7).

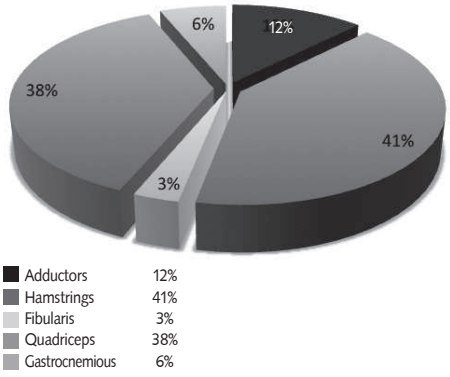

Figure 4: prevalence of injuried muscles

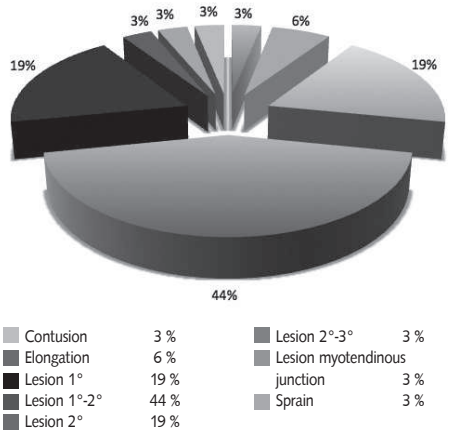

Figure 5:
prevalence of type of muscle damage

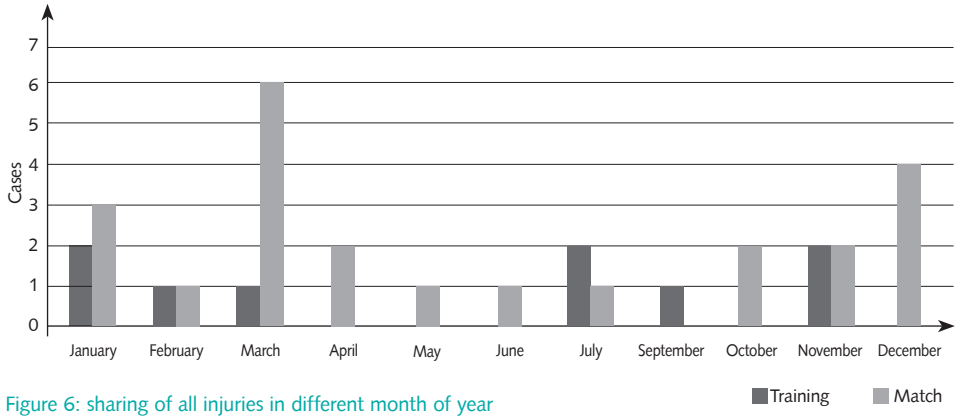

Figure 6: sharing of all injuries in different month of year

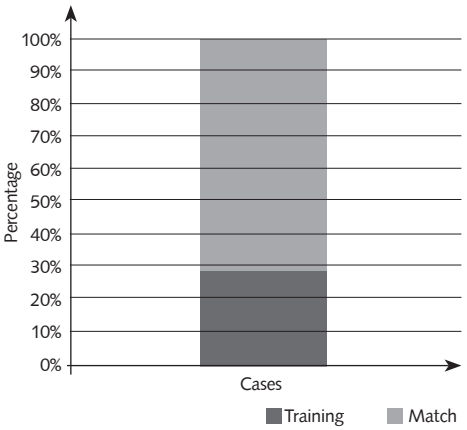

Figure 7: prevalence of injuries occurred in match/training

DISCUSSION

As demonstrated by statistical analysis, the comparison between the average recovery time of groups 1 (control) and that of group 2 (laser treated) does not show significant differences (Graph 2). The average recovery time of group 2 was slightly higher (1 day more), apparently giving the impression that the treatment can delay recovery. A more detailed analysis, which takes into account the kind of muscular injuries (Graph 3), reveals that in group 1 there were many patients with less severe lesions (lesion 1° and mild strain, expected to have a fast recovery) than the injuries affecting patients of group 2. Obviously the lower average recovery time of group 1 strongly depends on the lower seriousness of the lesions
The statistical analysis performed on subgroups of patients more homogeneous regarding to the injury(subgroups with "lesion 1°-2°" and "lesion 2°"), therefore more correct because each group (control and laser treated) had the same kind and degree of muscular injury, shows that both in the subgroup "lesion 1°-2°" and in the subgroup "lesion 2°" the patients treated with laser therapy had a faster recovery in comparison with controls. The application of laser therapy to the subgroups "lesion 1°-2°" and "lesion 2°" decreased the average recovery time of 3 and 4 days, respectively. Statistically, these differences are not significant, due to the low number of patiens studied. However the results suggest that MLS laser therapy improves the recovery from injury.
The muscles most frequently injured are hamstring (41% of our observations) and quadriceps (38% of our observations); this is explained by the acts of run, jump and shot, all very stressful actions for flexor and extensor of lower limb. These data agree with numerous studies reported in literature, for example the study of Hawkins & Fuller [2] and the study of Ekstrand & al [3].
The most frequent kind of injury observed was the lesion 1°-2° (44% of our observations): this is a lesion characterized by intermediate characteristics between 1° and 2° in relation with number of muscle fibres damaged, presence of oedema and hematoma. This classification is described in other scientific reports, for example Costantino C. & Imperio G [13].

The distribution of accidents during the shows that in the coldest months, from October to March, there is an increased risk of injury [14-16]. The peak of injuries has been recorded in March, with 6 of total 32 cases. In this period of the season there are lots of matches, national cup and national league; the high intensity of competitive activity together with the cold climate causes a high risk of injury.
Finally, we also analyzed when muscle injuries which affected our patients occured: 72% of the injuries occurred during football matches and 28% in training sessions. The difference between these two percentages is statistically significant, so we may assert that in football matches there is a higher risk of muscles injury than in training session.

CONCLUSIONS

In spite of a positive trend in cases of "lesion 1°-2°" and "lesion 2°", in which we demonstrated a shorter recovery time for patients who have done the rehabilitation program with laser therapy (group 2), this is not statistically significant. A limit of our study is the low number of patients enrolled, which is largely responsible for the absence of significance from the statistical point of view. However, the results of this pilot study indicate that the application of laser therapy can shorten the recovery time. This is an interesting cue for further studies with a larger number of patients.

Another limit of the study is that laser therapy was always joined with diathermy treatment (Tecar®).

The Tecar therapy was obviously administered also to the control group, then the only variable in the comparison between the two groups (control and laser treated) was laser therapy. However, the association of two physical therapies makes it difficult to isolate the effects of the laser from those of Tecar. It would therefore be necessary to conduct further studies in which the behavior of a group of patients subjected only to laser therapy is analyzed.
In conclusion, the results of this study suggest that laser therapy could be a useful tool to favour muscle repair and shorten the recovery time but further studies are needed to better assess the effectiveness of laser therapy in favouring the recovery of athletes suffering for muscle diseases.

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