High power laser therapy treatment compared to simple segmental physical rehabilitation in whiplash injuries (1° and 2° grade of the *Quebec Task Force* classification) involving muscles and ligaments

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Summary

***Introduction*: whiplash is a frequent post traumatic pathology caused by muscle, tendon and capsular elements over stretching. The authors conducted a short term prospective randomised study to test the effectiveness of a multi wave High Power Laser Therapy (HPLT) versus conventional simple segmental physical rehabilitation (PT) included in Italian tariff nomenclature performance physiotherapy Study Design: prospective randomised study (Level II).**

***Material and methods*: the authors identified 135 homogeneous patients with whiplash grade 1 - 2 of the *Quebec Task Force* classification (QTFC). INAIL, the Italian National Workers Insurance, based in Milan, was reliable source for identifying patients.**

All patients with whiplash injuries grade 1 or 2 QTFC, were eligible for the study, starting from April 28 2010 to September 30 2010. Patients referred to a Coordinator (C.M.) who applied the inclusion and exclusion criteria. Patients who agreed to participate were randomly assigned to one of the two treatment groups. Dates for initial treatment session were arranged, including cervical spine X-ray, and assessment. Each patient gave informed consent for participation and agreed to adopt only the study treatment for 6 weeks. Group A (84 patients) was treated with High Power Laser Therapy (HPLT), Group B (51 patients) received conventional simple segmental physical rehabilitation (PT). During the treatment period, no other electro-medical therapy, analgesics or anti-inflammatory drugs were allowed. All patients were assessed at baseline (T0) and at the end of the treatment period (T1) using a Visual Analogical Scale (VAS), (T2) the date of return to work was registered afterwards.

***Results*: there was a reduction in VAS pain scores at T1. Group A (VAS = 20) Group B (VAS = 34,8) (p =0.0048).**
Laser treatment allowed quick recovery and return to work (T2). Group A after 48 days against 66 days of Group B (p=0.0005).
***Conclusions*: results suggest that High Power Laser Therapy - is an effective treatment in patients with whiplash injury, compared to conventional simple segmental physical rehabilitation.**

KEY WORDS: whiplash, neck rehabilitation, laser therapy.

Introduction

The number of cervical traumas is very high. Only in United States it's over a million every year, mostly due to car accidents. In Italy whiplash is reported in 30% of car accidents, in 2007 more than 116.000 cases were registered[1].
Generally, a whiplash recovery is within 2-3 months, although in 10 - 30% of patients, neck pain and headache are still reported even after 2 years. 6% do not go back to work after a year[2,3].
Despite the large number of whiplash cases, physiopathology causing symptoms is still unknown: probably it starts with an excessive stretch of the cervical facet capsular ligaments, nociceptors alterations and strain of the myofascial and tendon components[4-6].
Usually in Public Physiotherapy patients are treated with manual therapy and passive and active exercise[7,8]. Technology has introduced HPLT that emanates triple wavelength radiations at the same time, working 8/10 cm deep, improving efficacy[9-11].
These devices are referred to as "class IV" reaching 7.500 mW power following previous "class III" or low level laser that had a limited power up to 500 mW.
Class IV had good anecdotal reports of effectiveness although limited scientific evidence, mostly in trauma related to sports.
For this reason we tested HPLT on patients with whiplash grade 1-2 QTFC comparing results to a traditional physical therapeutic protocol .

Patients and methods

From April 28 2010 to September 30 2010, 135 patients were recruited for the study. All presented whiplashes

between 1-2 of the Quebec Task Force Classification of Whiplash Associated Disorders (1995) (Tab.1).
Exclusion criteria applied to patients eligible were: pre-existing neck pain, systemic disease (neoplasia, diabetes, rheumatoid arthritis), previous whiplash injury, skin lesions on neck and shoulders, pregnancy, compensation; claims pursued.
Time length between accident and therapy was almost the same for both groups (28.4 days for group A and 28.1 days for group B).
Patients were assessed twice by a Physiatrist (C.M): at baseline (T-0), and at the end of the treatment period (T-1). The Physiatrist, had never seen the patients before, and was blinded to the treatment group. The day of return to work was registered afterwards (T-2).
Clinical measures recorded at T-0 were: clinical examination, cervical spine X-ray in AP, LL, when needed trans oral projections.
Visual Analogical Scale (VAS) score: range from 0 (no pain) to 100 (worst pain). At T-1: clinical examination and VAS. At T-2: time length between diagnosis and recovery and time length between the beginning of the treatment and recovery.
Laser therapies (HLLT) and conventional simple segmental physical rehabilitation (PT) were performed by an experienced group of physiotherapists who exchanged random patients and treatments. Patients were divided, random, in two groups 84 patients, 49 female and 35 male, (group A) and 51 patients 24 female and 27 male, (group B) (Tab. 2).
Group A was treated, once a day, for 5 days, with HPLT- FP3 System®. It's a class IV laser therapy, which main characteristics are: Pins. = 12,0 Watt ± 10%, power density measured on the skin up to P = 6,5 Watt/cm2 ± 10%, triple wavelength radiations included in the therapeutic window: λ= 780 ÷ 1100 nm, temperature control system, the software checks the emission so that the increase in skin temperature does not exceed 2.5°C. The emission time is between 8 and 40 seconds, the maximum statistical probability for the effect of repolarization (ideal 20 sec.) with transfer of energy between 20 and 30 Joule.
Protocols of lasers emission by TOUCH LIFE REHAB (engineer G. Algeri) were covered by patent and prefixed in the software, in order to standardize treatments. The protocols, thanks to a impedancemetry, adapts the laser emission in Joule according to skin pigmentation, idratation and the percentage of tissue (scale 0 to 100) (Fig. 1). According to the registred protocol a laser application lasted in average 5 min, divided in 5 mini applications of 40 sec. each, with 20 sec. pauses in between.
The "trigger points" treatment involves the simultaneous issue of micro-rotating electric field and laser radiation automatically modulated. Group B was treated with conventional simple segmental physical.
Rehabilitation also called PT based on an active patient involvement and education, minimizing, when possible, manual therapy procedures using primarily self treatment strategies[12-17].

Table 1. Quebec Classification of Whiplash Associate Disorders (WAD).

Grade	Clinical Presentation
0	No complaint about the neck No physical signs
1	Neck complaint of pain, stiffness or tenderness only. No physical signs
2	Neck complaint and musculoskeletal signs. Limited range of motion, point tenderness
3	Neck complaint and neurological signs. Decreased deep tendon reflexes sensory deficits
4	Neck complaint and fracture or dislocation

Table 2. Patients.

	Total		Gender			
			Female		Male	
	N	%	N	%	N	%
Group A laser	**84**	**100.0**	**49**	**58.3**	**35**	**41.7**
Group B PT	**51**	**100.0**	**24**	**47.1**	**27**	**52.9**
Total	**135**	**100.0**	**73**	**54.1**	**62**	**45.9**

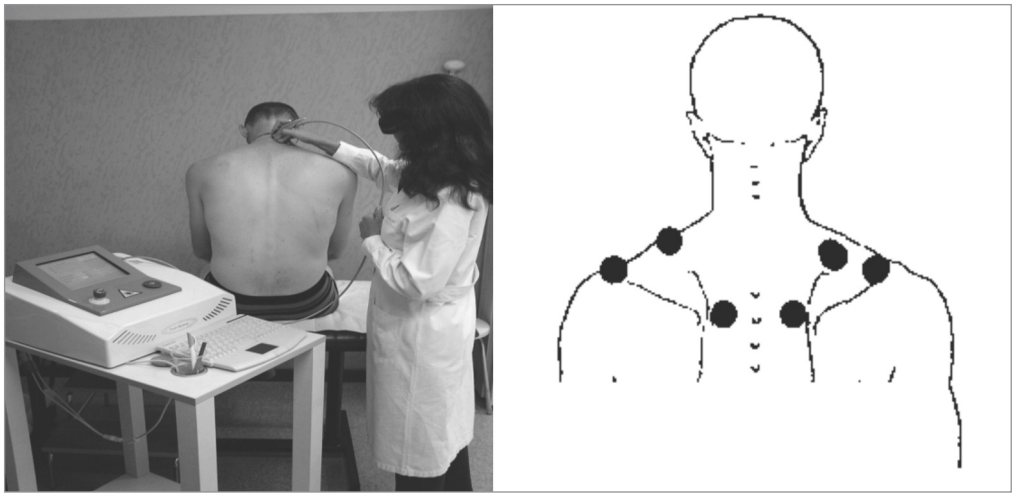


Figure 1. The operator treated the painful area.

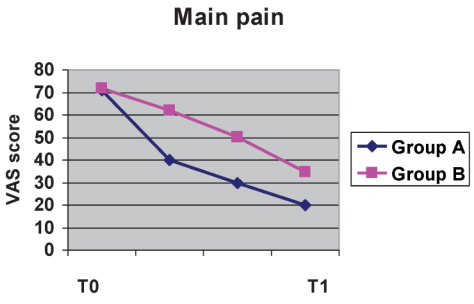
According to INAIL's guideline, each patient of Group B was assisted, by a physiotherapist for average 30 minutes, once a day, every three days, concluding 10 treatments.

Results

Patients presented no significant differences according to gender, age, pain, general conditions, clinical status, time length since the accident occurred, use of the collar, spine mobility.
We considered the final Visual Analogical Scale (VAS) and variation of percentages, as results of pain treatment. Pre treatment VAS shows patients had a comparably high level of pain an average score of 71.4 for group A and 71.7 for group B.
At T1 we found a reduction of pain in both groups. Final VAS score was 20 for group A and 34.8 for group B (Fig. 2).
We also considered time needed to obtain the results and to get back to work.
Patients of group A were able to go back to work after 54.2 days from the accident, versus 82.0 days for group B, therefore at T2 temporary inability of group A was -27% ($p<0.0001$) (Fig. 3).

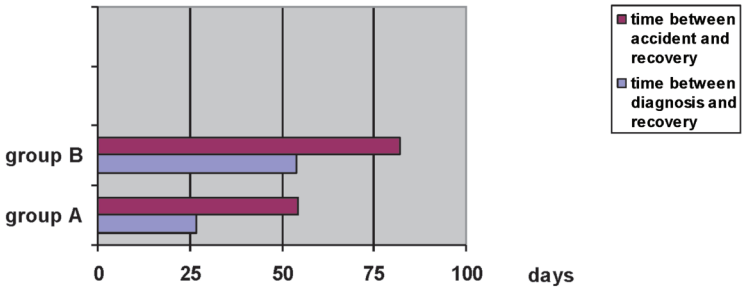
Discussion

In this study HPLT's efficacy has been compared to physical therapy and manual therapy, usually adopted to treat whiplash symptoms. Pain is the main problem originated by whiplash in grades 1-2 of the QTFS, therefore the treatment evaluation is based on VAS changes and time of recovery.
Patients treated with HPLT presented VAS improvement average score, 51.9 allowing quick recovery and return to work, versus 32.9 PT the time length between diagnosis and recovery was 26.6 days for the HPLT group and 53.9 days for PT group.
The Task Force 2000-2010 has published a critical revision on literature from 1980 to 2006 concerning non invasive treatments on cervical pain due to whiplash[18-25].
It concludes saying that: cervical pain due to whiplash responds better to video-guided treatments, mobilization, physical exercises rather than gymnastics, medications, cortisone infiltrations, collar use, electro stimulations, ultrasounds, tens[26-32].
Since the 80's laser has been used for medical purposes, for surgery and physical therapy. As a matter of fact when a laser ray, with a wave length between 600 and 1300 nm, hits a biological tissue, it produces a pho-



	Patients	Initial VAS T 0	Final VAS T 1	Standard deviation	Average *	Standard deviation
Group A Laser	84	71.4	20	8.5	51.9	12.4
Group B PT	51	71.7	34.8	13.5	32.9	13.3

Figure 2. Vas Variation *VAS improvement average score T-test p=0.0048.



	Patients	Days D / R	Standard deviation	Days A / R	Standard deviation
Group A Laser	84	26.6	20.3	54.2	26.7
Group B PT	51	53.9	49.1	82.0	63.2

Figure 3. Time length between diagnosis and recovery (Days D / R) T-test p=0.0005. Time length between accident and recovery (Days A / R) T-test p=0.0048.

tochemical effect called "photo modulation"[33-36].
Later was proved that basically all this is due to important cell modifications such as a mytocondrial stimulation with an increasing production of ATP and activation of microcirculation, peristalsis activation, analgesic effects due to hyperpolarization of the nerve decreasing excitability of algoreceptors. Transformation of prostaglandines in prostaciclines produces the inhibition of inflammatory mediators adding also anti edema effect, neovascularization.
These modifications such as anti-inflammatory and analgesic effects, are related to density of power. (ΔP = W/cm2), energy supplied, E = P.T (sec) and how the photonic beam penetrates the body.
The first therapeutic laser in the U.S. was cleared by the FDA in 2002 and had an output of 5 mW of power. A possible bias of this report might be the fact that there is no placebo control group.
Its possible that placebo associated to a machine is probably greater than that associated to manual therapy and conventional treatment.
Mulcahy et al. conducted a prospective, double blind trial of low level laser therapy (LLLT) in musculoskeletal injuries, to asses its efficacy and they concluded that LLLT acts primarily as a placebo. On the other hand, Da Silva et al. studied the effects of LLLT on subjects with intra- articular temporomandibular disorders. They randomly divided 45 subjects into three groups, the first two groups were submitted to a different therapeutic energy dose, the third was placebo. Therefore it was concluded that the use of LLLT increased the mean mandibular range of motion and reduced painful symptoms in the groups that received effective treatment, which did not occur in the placebo group. A controlled randomised double blind study, proves that the Low Level Laser Therapy (LLLT) reduces pain from 2 - 3 to 12 weeks compared to placebo on neck pain not due to whiplash. Other articles talk about efficacy of laser therapy on neck pain due to myofascial syndrome.
Kumar et al. published a study to evaluate the efficacy of combining electro therapy with amitriptyline for the management of chronic painful peripheral neuropathy patients with type two diabetes. They showed a reduction in pain related to placebo effect in the sham group but the outcomes indicated a substantial beneficial effect of electrotherapy over and above any placebo influence[37-46].
Therefore, there are various degrees of placebo effects related to a machine, but probably in our study different outcomes of pain and total recovery, between the two groups, were too different, to be explained only as placebo.
The expansion of the health care provider's armamentarium to include laser therapy for pain management, inflammatory reduction and accelerated healing has pointed to the need for higher output levels and, similarly, led to implementation of higher wavelengths with deeper penetration in tissue.
Therapeutic laser devices are now being manufactured to meet the needs of deeply seated conditions. These devices are referred to as class IV, or "high-power" therapeutic lasers, and have been cleared for use by the FDA up to 7,500.
As a matter of fact HPLT increases power and penetrates deeper in the body (8/10 cm)[47].
HPLT laser therapy seems to be an effective instrument to treat fascial, capsular, tendon and muscle pain originated by trauma.

Conclusions

Both HPLT therapy and conventional simple segmental physical rehabilitation (PT) are effective, on whiplash grades 1-2 of the QTFS. However, patients treated with HPLT compared to conventional simple segmental physical rehabilitation (PT) presented a better outcome (final VAS = - 50%) and were able to go back to work earlier (temporary inability = - 27%).
HPLT is appreciated being a non invasive, non aggressive, painless treatment with no complications.

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