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Laser and Thermal therapy in athletes' tennis elbow: an observational study.

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TITLE PAGE

Title: Laser and Thermal therapy in athletes' tennis elbow: an observational study.

Titolo: Laser e terapia termica nel gomito del tennista degli atleti: uno studio osservazionale.

Authors

Francesco Agostini[1], Andrea Bernetti[1], Gabriele Santilli[2], Marco Paoloni[1], Valter Santilli[1], Massimiliano Mangone[1]

Affiliations

[1] Department of Anatomical and Histological Sciences, Legal Medicine and Orthopedics, Sapienza University of Rome, Rome, Italy.

[2] Physical Medicine and Rehabilitation Unit, Sant'Andrea Hospital, "Sapienza" University of Rome, Rome, Italy

Corresponding Author

Andrea Bernetti Department of Anatomical and Histological Sciences, Legal Medicine and Orthopedics, Sapienza University of Rome, Piazzale Aldo Moro 5, 00185, Rome, Italy.

Email andre.bernetti@uniroma1.it **Mobile** +39 3209467954

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ABTRACT

BACKGROUND: Lateral epicondylitis (LE), is a widespread painful situation in the upper extremity that usually occurs due to overuse of the wrist extensor muscles. The aim of our study was to investigate the analgesic and functional effects of laser therapy in association with thermal therapy in sports patients suffering from lateral epicondylitis.

METHODS: We retrospectively analyzed amateur tennis patients who played sports at least 3 times a week, with medical and ultrasound diagnosis of subacute lateral epicondylitis. All patients underwent 6 sessions of Laser therapy with qmd® Helios laser. A group of patients instead (23, Thermal-Laser Group, TLG), underwent a session of Thermal therapy (qmd® Helios cryo-thermal) before the Laser therapy. The Laser Group (21, LG) on the other hand only performed laser therapy. Patients included in the study were evaluated at baseline (T0), at the end of treatment (T1) and after 15 days from the end of treatment (T2) through Visual Analogue Scale-VAS, muscle strength (Dynamometer) and function (Disabilities of the Arm, Shoulder and Hand-DASH questionnaire).

RESULTS: Fifty-two patients (23 M, 21 F) were enrolled (21 LG; 23 TLG). All evaluations performed show significant improvement over time in both groups. The TLG shows at T1 a greater increase in force compared to the LG.

CONCLUSIONS: Laser therapy has certainly been an effective intervention in the management of epicondyle pain for some time. More studies with a higher number of patients and longer follow-up are needed in order to better characterize the benefits of this combination therapy.

Keywords: Joint; Pain; Lateral epicondylitis; Laser therapy; Thermal therapy; Sport

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INTRODUCTION

Lateral epicondylitis (LE), lateral elbow tendinopathy or tennis elbow are common terms for a widespread painful situation in the upper extremity that usually occurs due to overuse of the wrist extensor muscles [1, 2]. The insertion of the common extensor on the lateral epicondyle of the humerus undergoes micro-tears associated with a chronic repair process, but almost no inflammation. For this reason, the term tendinopathy is the most correct term. This tendinopathy has a prevalence of 1 to 3% and is highest in individuals> 40 years of age. Due to the excessive and repetitive stress that strains the extensor tendons of the forearm, degeneration of the extensor radial short carpus tendon (ECRB) occurs [1-3]. It is considered a disabling disease and, in 20% of patients, it can persist for over 1 year. It is often associated with a biomechanical overuse (e.g. work, sport, etc.) involving both the wrist and elbow joints. LE has a great impact on patients' social and personal lives, especially in activities of daily living (ADL) and its disease burden continues to increase every year [4-6]. Pain and tenderness on the lateral epicondyle of the humerus at the origin of the common extensor tendon are the main pathological features [7-9]. Several methods of conservative treatment (physical instrumental therapy, physiotherapy, exercises, splinting, anti-inflammatory drugs, corticosteroids, Hyaluronic acid and autologous blood and platelet-rich plasma injection) have been used for the treatment of LE; however, no standardized protocols have been documented in the literature. A combined approach is currently particularly recommended in the literature [10-17]. Patients with LE resistant to conservative measures often request surgical treatment [18]. In the context of instrumental physical therapies, as far as the conservative treatment of epicondylitis is concerned, certainly those most used and which have the greatest evidence in the literature are laser therapy, thermal-therapy, therapeutic ultrasounds, and extracorporeal shock wave therapy [19-25].

Laser therapy is widely used in the treatment of musculoskeletal pathologies (including lateral epicondylitis) thanks to its analgesic, anti-edema, anti-inflammatory and bio-stimulating effects. In

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most of the studies, the therapeutic frequencies used are 1120, 1064 and 808 nanometers, which are delivered individually [26, 27].

Generally, both hot and cold (Thermal therapy) can have a role in reduction of pain, promoting the healing of injuries and functional recovery. Thermal therapy is also frequently used in pathologies of the musculoskeletal system, with various purposes, not only individually, but which combines the effects of heat and cold (Contrast therapy) depending on the acuity or chronicity of the pathology in progress [28, 29].

At the present stage, there is no evidence in the literature about a combined approach of laser therapy and thermal therapy in sports patients suffering from lateral epicondylitis. The aim of our study was to investigate the analgesic and functional effects of laser therapy in association with thermal therapy in sports patients suffering from lateral epicondylitis.

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MATERIALS AND METHODS

We retrospectively analyzed amateur tennis patients who played sports at least 3 times a week, with medical and ultrasound diagnosis of subacute lateral epicondylitis (<3 months), who had come to our observation in the period September-January 2020.

The inclusion criteria were: ages between 20 and 60, presence of significant pain at the level of the lateral epicondylitis during activities of daily life, such as playing tennis, opening a bottle, driving, etc.; presence of significant acupressure pain at the level of the humeral epicondyle in correspondence of the osteotendinous junction of the origin of the wrist and finger extensor muscles; increased pain during active dorsiflexion of the wrist and third finger against resistance with the elbow in extension; evidence of tendon distress on ultrasound examination.

Patients with concomitant systemic rheumatic disease, patients suffering from cervical pathologies, bone disease, elbow instability, tendon calcifications, ulnar nerve entrapment, and those who had been operated on or had received local infiltrations or recent elbow treatments were excluded from the study, or who had experienced severe trauma.

Patients with pathologies that contraindicate the use of instrumental physical therapy such as infections in the segment to be treated, diabetes or tumors were also excluded [30].

At the first evaluation, all patients had stopped sport due to pain. The study was conducted in accordance with Helsinki ethical standards and has the ethical approval of the Department of Anatomical, Histological, Forensic and Locomotor Sciences of the Sapienza University of Rome. Patients were informed about the possible side effects of the treatment. All patients signed informed consent forms [31].

Interventions

After enrollment, the patients included in the study were subsequently randomized in excel by using RAND formula into two groups. All patients underwent 6 sessions (one session per day, six

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consecutive days) of Laser therapy with qmd® Helios laser. A group of patients instead (23, Thermal-Laser Group, TLG), underwent a session of Thermal therapy (qmd® Helios cryo-thermal) before the Laser therapy. The Laser Group (21, LG) on the other hand only performed laser therapy. The patient was positioned seated on a chair, with the elbow flexed resting on a table, with the forearm and the palm of the hand resting on the surface of the table, while a physiotherapist, expert in the method, carried out the treatment.

Thermal therapy

Thermal therapy was administered using contrast therapy program, or the rhythmic administration of hot and cold, in order to induce phases of vasoconstriction and vasodilation, an advantageous technique for the resolution of edema of inflammatory and traumatic origin. The "contrast therapy" program performs two cycles of one minute each of hyperthermia at +40 ° C and three minutes of cryotherapy at +5 ° C. Thus, alternating hot and cold we obtain vasoconstriction and vasodilation in order to activate the pump effect However, by finishing the cycle with cryotherapy, we exploit the anti-inflammatory and analgesic effect of cryotherapy.

Laser therapy

The sessions were carried out using the laser's "anti-inflammatory effect" program which includes a fixed wavelength phase (808 nanometers) in order to exploit only its anti-inflammatory power and a frequency scanning phase (harmonic pulsation®), a pulsed mode frequency scan able to regulate healing processes in a global way and able to guarantee the widest spectrum of biological effects During the scan, the stimulation parameters vary continuously in order to optimize the relationship between stimulus duration and intensity. Scanning is included in all therapy schemes for its effectiveness and versatility.

Evaluations

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Patients included in the study were evaluated at baseline (T0), at the end of treatment (seventh day-T1) and after 15 days from the end of treatment (T2). At all three times, pain (Visual Analogue Scale-VAS), muscle strength (Dynamometer) and function (Disabilities of the Arm, Shoulder and Hand-DASH questionnaire) were assessed before the therapy. A tendon ultrasound evaluation was also performed at T0 (diagnostic assessment) [32, 33].

VAS

The Visual Analogue Scale (VAS) is a tool for measuring the subjective characteristics of the pain experienced by the patient. The scale consists simply of a 10 cm strip of paper that has two "end points" at the ends which are defined as "no pain" and the "worst pain I can imagine". The healthcare professional asks the patient to mark the pain as it is perceived at that moment at a point on the scale. The interval between the two extremes (end points) is marked every centimeter and allows to attribute a value to the subjective disturbance, the pain, perceived by the patient [34, 35].

Dynamometer

A single Baseline hydraulic Hand Dynamometer (Fabrication Enterprises, White Plains, USA) was calibrated according to the manufacturer's specifications. The researchers demonstrated the activity to the patients, instructing them to generate as much force as possible during a single repetition. Hand grip strength was recorded in each individual session prior to therapy. Each participant was instructed to sit in an armless chair with the soles of their feet touching the floor. Participants had torso erect, elbow flexed to 90 degrees, in order to exclude the forearm flexor muscles, with forearm and wrist in neutral position. Each patient was instructed to tighten the dynamometer handle as tightly as possible. The average of 5 tests was taken into consideration and used for the analyzes, with a rest period of 30 seconds between one and the other, to avoid the temporal sum of pain [36, 37].

DASH

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The DASH questionnaire is a 30-item questionnaire that looks at the ability of a patient to perform certain upper extremity activities. It is an upper-extremity specific outcome measure that was introduced by the American Academy of Orthopedic Surgeons in collaboration with a number of other organizations. This questionnaire is a self-report questionnaire that patients can rate difficulty and interference with daily life on a 5-point Likert scale. The rationale behind the use of one outcome measure for different upper extremity disorders is that the upper extremity is a functional unit. In this respect, the DASH would be suitable because of its property of being mainly a measure of disability. Considering the nature of the instrument, longitudinal construct validity can be assessed among a group of patients with different upper extremity disorders [38-40].

Statistical analysis

For the statistical analysis, the IBM SPSS v.25 software was used, the data are expressed in terms of medians and range of variation. To evaluate the differences over time of the scales used in the two groups, the Friedman test for repeated measures on non-parametric data was used. The values of the deltas between the times of the individual variables were also evaluated (delta Dash i-j, differences between the values of the Dash calculated in each group at time i and at time j). The differences between the calculated delta values in the two groups were evaluated using Mann Whiney non-parametric test [41, 42].

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RESULTS

Fifty-two patients (23 M, 21 F) who met the inclusion criteria were included in our study. Eight patients dropped out of care (last follow-up) for personal, non-care reasons. Of the forty-four patients included, twenty-one had undergone treatment with laser therapy (LG) and twenty-three with combination of thermal therapy and laser therapy (TLG). There were no adverse effects after the treatments. Table 1 summarizes the characteristics of the included patients.

All evaluations performed show significant improvement over time in both groups. The TLG shows at T1 a greater increase in force compared to the LG (Table 2) (Figure 1-3).

At the end of the treatment, 85% of patients resumed sport without pain.

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DISCUSSION

The aim of our study was to compare the effects on pain and return to emotional activity of two rehabilitation interventions that included the combined use of heat therapy and laser therapy or laser alone in patients with epicondylitis. The results of our study show that both protocols are effective in reducing epicondylitis pain and returning to sports. The therapeutic protocol that combines laser therapy with thermal therapy showed a faster improvement over time, especially at T1, which, however, is equaled to T2 by the protocol that used only laser therapy. These results show that the combination of the two treatments is equally effective in the long term and guarantees a faster resolution of pain and a return to sports activity.

In 2008, Bjordal et al., Conducted a meta-analysis with the aim of studying the effects of laser therapy on epicondylitis. The authors concluded that laser therapy administered with optimal doses of 904 nm and possibly 632 nm wavelengths directly to the lateral elbow tendon insertions appears to offer short-term pain relief and less disability in epicondylitis, both alone or in combination with an exercise regimen [22].

In 2011, Bisset et al., In order to highlight which were the most effective therapeutic interventions and with the greatest evidence in the literature, carried out a systematic review, aimed to answer the following clinical question: What are the effects of treatments for tennis elbow? The authors, regarding laser therapy, concluded that conflicting data and heterogeneity between RCTs suggests that caution should be taken in drawing conclusions regarding the effects of laser therapy. However, it seems that laser therapy using a 904 nm wavelength applied directly over the tendon area may be effective in reducing pain and improving functional outcomes in the short term in people with tennis elbow [43].

In 2015, however, Weber et al., Published a meta-analysis to study the efficacy of instrumental physical therapies on patients with epicondylitis. In contrast to Bjordal et al. this meta-analysis

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identified only 2 laser therapy studies that both met the inclusion criteria and published sufficient data for the meta-analysis [44].

In 2020, Turgay et al., Conducted a prospective study in order to compare the efficacy of extracorporeal shock wave therapy versus laser therapy in the treatment of chronic lateral epicondylitis. The authors concluded that both treatment modalities were effective in treating chronic lateral epicondylitis [19].

Thermal therapy is nowadays widely used as a therapeutic and rehabilitative treatment in numerous pathologies of the musculoskeletal system for analgesic and anti-inflammatory purposes [45].

The pathologies most frequently studied and with the greatest evidence are tendinopathies and muscle injuries. The purpose of their use is to improve short-term pain and inflammatory symptoms thanks to the effect of heat administration or burial [46].

Surely thanks to its feasibility of use, it is particularly used in sports [47, 48].

Precisely for the characteristics mentioned above, we have hypothesized an insertion in the therapeutic process in order to achieve a faster resolution of the painful symptoms. In fact, our data are consistent with those currently present in the literature which show a recovery and a return to the activity that arose for both protocols used, but with a faster resolution of the pain symptoms in patients who, in addition to laser therapy, had performed a cycle of thermal therapy.

Limitations

Certainly, our study is not without limitations. The small number of samples and a longer-term follow-up certainly represent a limitation. The lack of data on patients undergoing only one cycle of thermal therapy without laser therapy represents another limitation [49, 50].

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CONCLUSIONS

Laser therapy has certainly been an effective intervention in the management of epicondyle pain for some time. The introduction of thermal therapy, especially by virtue of its effects and also of its feasibility in a sports environment, could provide a greater contribution in the return to sports activity in this category of patients. More studies with a higher number of patients and longer follow-up are needed in order to better characterize the benefits of this combination therapy.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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AUTHORS' CONTRIBUTION

Conceptualization, Andrea Bernetti, Francesco Agostini and Marco Paoloni; methodology, Francesco Agostini; software, Massimiliano Mangone; validation, Massimiliano Mangone and Gabriele Santilli; formal analysis, Francesco Agostini; investigation, Andrea Bernetti; resources, Valter Santilli; data curation, Marco Paoloni and Massimiliano Mangone; writing—original draft preparation, Andrea Bernetti and Francesco Agostini; writing—review and editing, Francesco Agostini; visualization, Valter Santilli; supervision, Marco Paoloni; project administration, Francesco Agostini and Andrea Bernetti; funding acquisition, none. All authors read and approved the final version of the manuscript

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Table 1. Demographic parameters.

Clinical parameters	Laser Group (21)	Thermal-Laser Group (23)	P value
Age (years – mean standard deviation)	45±10,09	45,7±10,5	0,487
BMI (mean standard deviation)	21,8±2,3	21,9±1,8	0,567
Gender (n)	13M 8F	10M 13F	0,122
Dominant side (%)	100 right; 0 left	100 right; 0 left	-
Pain side (%)	100 right; 0 left	100 right; 0 left	-

BMI= Body Mass Index; Mean and standard deviation.

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Table 2. Evaluations.

		T0	T1	T2	P value
Hand Grip TLG		85,63002	89,55682	88,53409	**0,032**
Hand Grip LG		85,59827	86,17519	87,79323	**0,049**
P value		0,99661	**0,045**	0,910911	
VAS TLG		6,7	4,5	4	**0,041**
VAS LG		6,1	5,2	4,3	**0,033**
P value		0,9	**0,046**	0,7	
DASH TLG		32	21	13	**0,044**
DASH LG		35	28	15	**0,043**
P value		0,8	0,08	0,64	

TLG: Thermal-Laser Group; LG: Laser Group; VAS: Visual Analogue Scale; DASH: Disabilities of the Arm, Shoulder and Hand questionnaire.

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FIGURE LEGENDS

Figure 1. Hand Grip evaluation.

Figure 2. Visual analogue scale (VAS) evaluation.

Figure 3. Disabilities of The Arm, Shoulder and Hand (DASH) evaluation.

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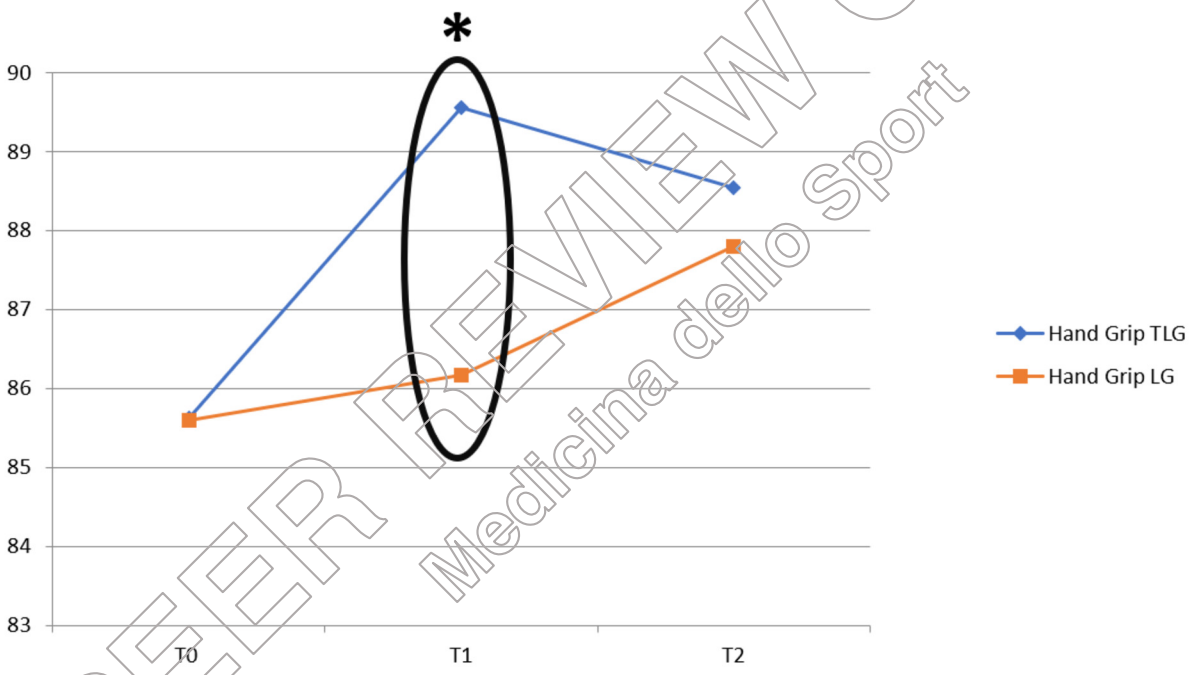

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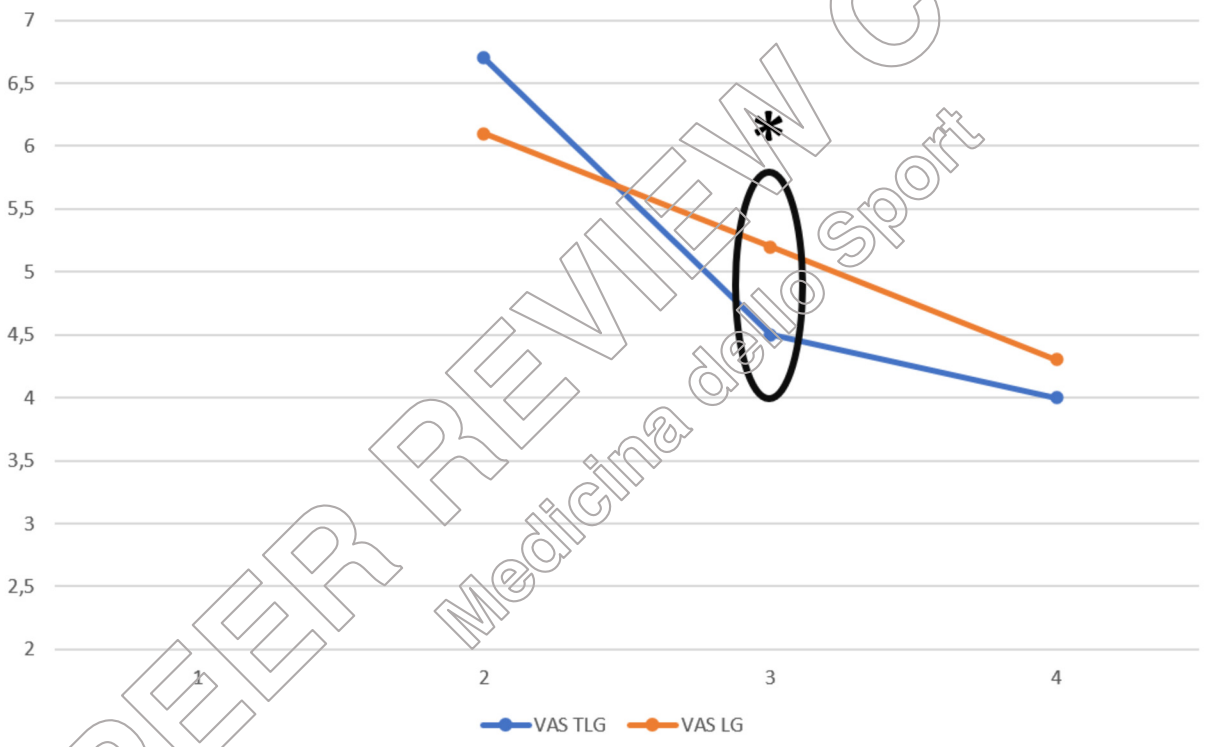

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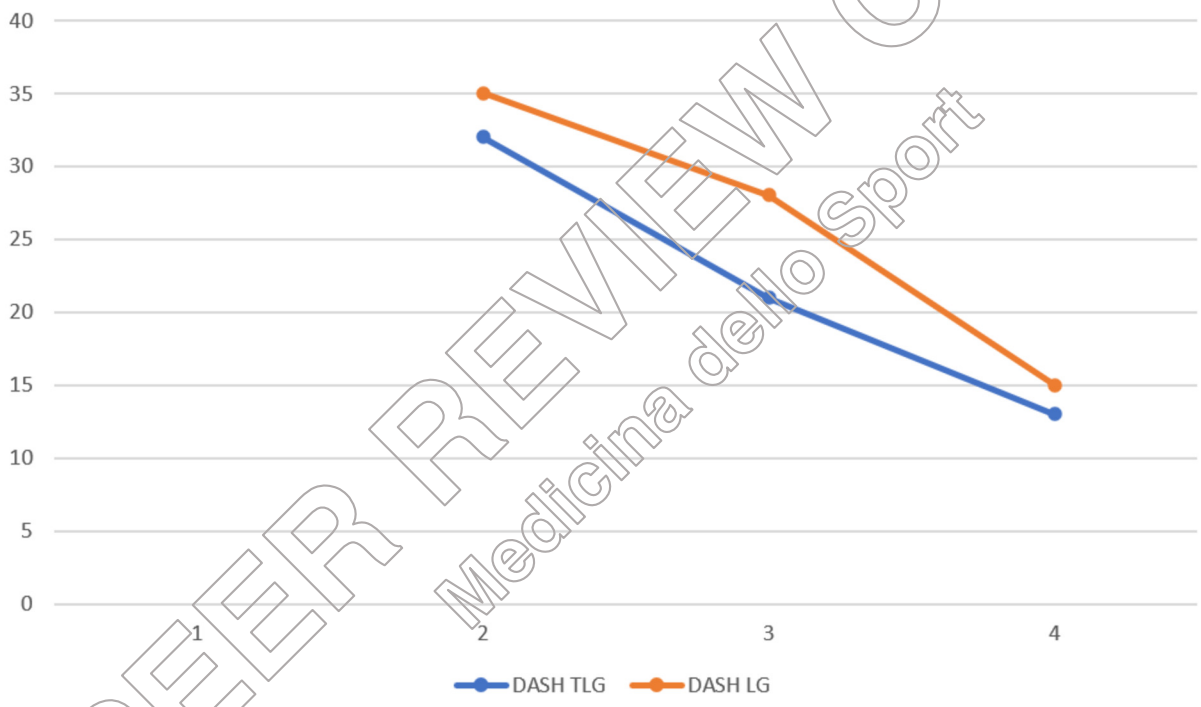

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