Management of chronic Achilles tendinopathy with High Intensity Laser Therapy (HILT®) and eccentric exercises.

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ABSTRACT

Achilles tendinopathies are classic pathologies due to functional overuse that mostly affect sportspeople and that are characterized by degenerative rather than inflammatory alterations. They present risk factors which can be related to intrinsic features of the subject or independent from these. Achilles tendinopathies classify in insertional tendinopathies and non insertional tendinopathies. Non insertional tendinopathies are localized in the area between 2 and 6 cm from the calcaneus insertion and they are the most frequent ones. Insertional tendinopathies are instead localized within 2 cm from the insertion and they are frequently accompanied by posterior calcaneal and/or superficial bursitis. Among the recommended treatments, the eccentric exercises present the major evidences in literature. In this clinical study we selected 20 patients affected by Achilles tendinopathy and we divided them into two homogenous groups. In group A all patients have been treated with High Intensity Laser Therapy (HILT®) combined with eccentric exercises, while in group B patients have carried out eccentric exercises combined with a HILT® placebo. From the analysis of the data obtained through pain VAS scale and functionality VISA-A scale, it emerged that both groups obtained a progressive pain decrease and functionality increase. However, the group A (HILT® + eccentric exercises) achieved statistically better results compared to group B (eccentric exercises + placebo HILT®) with a pain decrease equal to 74% against 57% and a functionality increase equal to 90% against 64%. In conclusion, our clinical study pointed out that HILT® combined with eccentric exercises is able to achieve better results in respect to eccentric exercises alone.

INTRODUCTION

Achilles tendon is the thickest and strongest tendon of the human body. It connects the triceps surae muscle to calcaneus. Achilles tendinopathy is a classic pathology due to functional overuse, where repeated micro traumas determine tendon structural alterations which reduce the mechanical resistance of the tendon by exposing it to additional lesions [1,2].

Achilles tendinopathy has an high incidence in sportspeople, especially in running (11% of all sport- specific pathologies), dancing (9%), tennis (2-4%) and soccer (2,4%). On the other hand, in adult population it has a prevalence of 2,35 cases every 1000 requests of medical consultation [1,3].

The risk factors for Achilles tendinopathy can be divided into intrinsic factors if related to individual features and extrinsic factors if independent of the subject characteristics [2]. The main intrinsic factors are: poor vascularisation of Achilles tendon in its mid-portion, advanced age, overweight, postural or plantar defects, lower limbs dismetries, deficiency and asymmetry of muscle strength and elasticity, previous trauma. The main extrinsic factors are: incorrect training or working techniques, inadequate footwear, extremely hard playing fields or working surfaces, abuse of toxic drugs for tendons (chinolonics, corticosteroids).

From a pathological and anatomical point of view, Achilles tendinopathies classify in two categories [4]:

1. Insertional tendinopathy
2. Non insertional tendinopathy

Insertional tendinopathy [1,3] is localized in an area within 2 cm from the calcaneus insertion. It has a prevalence of 20-25% and it is characterized by insertional degeneration with thickening, micro calcifications and partial lesions. Frequently it is accompanied by superficial and/or posterior calcaneal bursitis.

The main causing factor of this kind of tendinopathy is the functional overuse in presence of foot supination or Pes Cavus. In the 25% of cases it is also present the Haglund's, deformity which consists in the alteration of the postero-superior prominence of the calcaneus. This deformity can determine an impingement

syndrome with posterior calcaneal bursa and with Achilles tendon in its ventral part during repeated flexion-extensions ankle movements.

Non insertional tendinopathy [1,3] or mid-portion tendinopathy is instead localized in the portion included between 2 cm and 6 cm from the insertion on the calcaneus, a portion that is affected by a minor blood supply. This typology of chronic tendinopathy is the most frequent one (55-65%) and potentially the most dangerous one because it is associated with a greater incidence of Achilles tendon rupture. Non insertional tendinopathy is characterized by tendon degeneration (or *Tendinosis*) without evidence of inflammation in the tendon context. Tendinosis appears with tendon thickening, disorganization of collagen fibers, non-collagenous matrix increase, cellularity alterations, neoangiogenesis, partial lesions of longitudinal type or more frequently ovalar [4]. Tendinosis is often accompanied by *Paratendinopathy* with paratenon inflammation, swelling and - in most chronicized forms - adhesions that limit the regular flowage of the tendon in its sheath. Neoangiogenesis phenomenon occurs in about 70% of symptomatic tendons [5]. *Neoangiogenesis* consists in the formation of new vessels accompanied by sensory nerves which starting from paratenon go deep into the tendon, mainly in its ventral portion.

Typical symptoms of Achilles tendinopathies are pain during and after physical activity, *tenderness on palpation and morning stiffness*.

The cause of pain in Achilles tendinopathies is still a subject of debate [6]. The mainly validated theory attributes the reason to the presence of sensory nerves that accompany new formed vessels during neoangiogenesis and that produce nociceptive and pro-inflammatory substances (Glutamic Acid and Substance P in particular).

The *conservative treatment* is the first approach to chronic Achilles tendinopathies, while surgery is reserved in case of conservative therapies failure for at least 6 months [7,8]. Among conservative treatments eccentric exercises have strong evidence especially in non insertional tendinopathies. There are several eccentric protocols among which the *Halfredson H.* [9] protocol is the most known. Among the instrumental therapies *Extracorporeal Shock Wave Therapy* has shown a moderate scientific evidence on Achilles tendinopathies, thanks to its known direct and indirect mechanical effects. Some protocols associate Extracorporeal Shock Wave Therapy to eccentric exercises with better results compared to single therapies.

Some randomized controlled studies on the animal highlight the therapeutic effects of *Low Level Laser Therapy* (LLLT) on Achilles tendinopathies [10]: modulation of inflammatory response following trauma, analgesic effect, antioxidant effect, effect stimulating the healing process by increasing collagen production (type I in particular) and tenocyte proliferation. Other conservative therapies like injections, orthoses, NSAIDs, cryotherapy, currently have limited evidence levels [7,8].

High Intensity Laser Therapy (HILT®) is a more recent methodology [11]. This technique comes from the awareness of Low Level Laser Therapy limits, like the limited penetrance inside the tissues and the inability of obtaining an efficient photomechanical effect. HILT® is indeed able to transmit elevated amounts of energy in the deepest tissues and induce photomechanical effects, thanks to high peak levels. Recent randomized controlled studies in literature highlight HILT® beneficial effects on some musculoskeletal apparatus pathologies like myofascial pain [12], subacromial impingement syndrome, gonarthrosis [13], low back pain [14] and Bell paralysis [15]. However there are not evidences yet about HILT® efficacy on Achilles tendinopathies. Purpose of this study is evaluating efficacy of HILT® combined with eccentric exercises on Achilles Tendinopathies.

MATERIALS AND METHOD

We selected 20 patients (16 males and 4 females; average age 40/41; range 24-57 years-old) affected by Achilles Tendinopathy. 14 patients were affected by *non insertional tendinopathy* (12 males and 2 females), 6 patients presented insertional tendinopathy (4 males and 2 females). The patients have been divided into two groups (A and B) homogenous for pathology, age and sex (Table I).

In *group A* all patients have been treated with 10 daily sessions of HILT® for two consecutive weeks, in association with an eccentric exercises program to do at home every day for 4 weeks.

The patients of *group B* have been treated with the same eccentric protocol as the patients of group A in association with 10 sessions of HILT® placebo (carried out without laser dispensing, but only with guide light).

Group	Age and Sex	Pathology	VAS at T0	VISA-A at T0
A	40,7 ± 11,96; 8♀,2♂	7 non insertional; 3 insertional	5,53 ±0,36	44,2 ±3,65
B	40,7 ± 11,96; 8♀,2♂	7 non insertional; 3 insertional	5,26 ±0,67	45,2 ±3,16

Table I: basal values (at T0) of the two groups.

The evaluation of each patient has been realized by means of pain VAS scale and functionality VISA-A scale. The VAS is a visual analog test which evaluates the subjective painful symptomatology. The score varies between 0 (lack of pain) and 10 (biggest imaginable pain). The VISA-A scale is a specific test for Achilles tendinopathies. It consists in 8 questions regarding pain, function and functional activities. The score varies between 0 (biggest limitation) and 100 (asymptomatic patient).

VAS and VISA-A have been carried out before the therapy (T0), two weeks after (T1) and 4 weeks after the beginning of the therapy (T2).

Data have been analyzed through Microsoft Office Excel software, considering them statistically significant with a value of P<0,05 and highly significant with P<0,001.

Hilterapia® protocol

In the present study all patients have been treated with SH1 device (ASA Srl, Arcugnano [VI], Italy). The patients of group A have carried out 10 daily sessions with the following parameters: fluence 760 mJ/cm^2, frequency 20 Hz and 2000 J of total energy. The scanning speed was slow. The patients of group B have been subjected to 10 daily sessions by only using the guide light of SH1 device (helium-neon source).

Eccentric exercises protocol

The patients of both groups have carried out at home 30 daily repetitions of eccentric exercises for 4 weeks. The exercises consisted in slow flexion-extensions of the ankles on a rung, followed by stretching exercises.

RESULTS

VAS Scale: Both groups highlighted a progressive pain decrease, with significantly reduced (P<0,001) VAS scores in respect to basal value both at T1 and T2 (Figure 1). The mean scores of the two groups before the treatment (5,53±0,36 in group A and 5,26±0,67 in group B) did not highlight significant differences (P=0,22). At T1 the scores were 1,82±0,32 for group A and 3,92±0,53 for group B, with a highly significant difference between the two groups (P<0,001) in favor of group A; at T2 the scores were respectively 1,4±0,37 for group A and 2,25±0,33 for group B, again with a highly significant difference between the two groups (P<0,001) in favor of group A.

In percentage terms, in group A VAS score was reduced by 67,1% at T1 and 73,6% at T2; in group B the decrease was equal to 31,2% at T1 and 57,2% at T2.

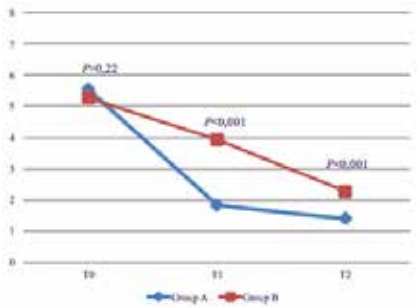

Figure 1: Mean values of VAS score.

VISA-A Scale: Functional scores examined with VISA-A scale also highlighted for both groups a highly significant improvement (P<0,001) in the mean scores both at T1 and T0 (Figure 2) in respect to basal score (T0). The mean scores of the two groups before the treatment (44,2±3,65 in group A and 45,2±3,16 in group B) did not highlight significant differences (P=0,34). At T1 the scores were 78,3±6,01 in group A against 59,8±4,34 of group B, with a highly significant difference (P<0,001) in favor of group A. The same happend at T2 with mean values of 84,1±3,75 in group A and 74,7±3,59 in group B. Therefore the differences between the two groups at T2 were highly significant (P<0,001).

In percentage terms, at T1 the VISA-A scores increase was equal to 77,15% in group A and 32,3% in group B. At T2 the increase was equal to 90,3% in group A and 63,9% in group B.

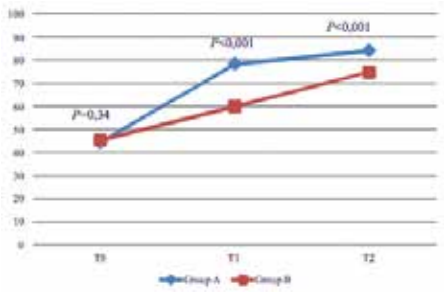

Figure 2: Mean values of VISA-A score.

DISCUSSION AND CONCLUSIONS

The greater knowledge of anatomic and etiopathological aspects of tendinopathies has, over the last few years, allowed the abandonment of the term Tendinitis in favor of the term Tendinosis, underlining the fact that chronic tendon pathology is characterized more by histological and biomechanical alterations rather than an inflammatory component. In parallel, it has been clearly highlighted that pain perception in tendinopathies is not much linked to tissues inflammation, but more to the presence of new formed sensory nerve endings that produce nociceptive and pro-inflammatory substances. Tendinopathy treatment has also conformed to these "new" concepts, being seen more and more like a multimodal treatment oriented to stimulation of tendon regeneration and painful stimulus inhibition. In this sense the eccentric exercises protocols have been shown to have positive effects on tendon structure, its mechanical resistance and on the reduction of nociceptors [9].

In this clinical study we have therefore focused our attention on chronic Achilles tendinopathies treatment with HILT® combined with eccentric exercises, compared to eccentric exercises alone.

From the obtained data we can highlight that group B, treated with eccentric exercises alone, had a progressive and gradual pain decrease and functionality increase with a slow and constant trend.

After two weeks of treatment, the VAS mean score decreased by 31,2% and mean VISA-A score increased by 32,3%; after four weeks VAS score reduced by 57,2% and VISA-A score increased by 63,9%.
Different trend had the data obtained from the group of patients treated with eccentric exercises combined with HILT® (group A). After two weeks VAS score decrease and VISA-A score increase were more sudden (VAS –67,1%; VISA-A +77,15%), highlighting that the combination of High Intensity Laser Therapy with eccentric exercises allowed to achieve significantly better results. Between two and four weeks the trend of VAS decrease and VISA-A increase curve proved to be more similar to that of group B. That happened because in that period the patients of group A carried out only eccentric exercises, as well as those of group B.
In conclusion, according to the current scientific evidences the eccentric exercises play an essential role in Achilles tendinopathy healing process. Our study has confirmed this evidence and furthermore has highlighted that by associating eccentric exercise with HILT® therapy it is possible to reduce pain in a stronger and more precocious way and, at the same time, significantly increase functionality in patients affected by Achilles tendinopathy.
However, we believe that the achieved results are preliminary, being necessary the using of a larger population and a longer follow-up.

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REFERENCES

1. Ishikawa SN, Donley BG, Richardson DR, Murphy GA. Achilles Tendinopathies. Sports Injuries, 2014.
2. Magnan B, Bondi M, Pierantoni S, Samaila E. The pathogenesis of Achilles tendinopathy: A systematic review. Foot Ankle Surg., 2014, Sep;20(3):154-159.
3. Roche AJ , Calder JDF. Achilles Tendinopathy. Bone Joint J, 2013, 95-B:1299–1307.
4. Del Buono A, Chan O, Maffulli N. Achilles tendon: functional anatomy and novel emerging models of imaging classification. Int Orthop., 2013, Apr;37(4):715-21
5. K Sunding, M Fahlström, S Werner, M Forssblad, W Lotta. Evaluation of Achilles and patellar tendinopathy with greyscale ultrasound and colour Doppler: using a four-grade scale. Knee Surgery, Sports Traumatol Arthrosc, 2014 –Springer.
6. Maayke van Sterkenburg N, Niek van Dijk C. Mid-portion Achilles tendinopathy: why painful? An evidence-based philosophy. Knee Surg Sports Traumatol Arthrosc, 2011, 19:1367–1375.
7. Loppini M, Maffulli N. Conservative management of tendinopathy: an evidence–based approach. MLTJ, 2011, 1(4): 134-13.
8. Roche A. J., Calder J. D. F. Achilles tendinopathy. A review of the current concepts of treatment. Bone Joint J, 2013, 95-B:1299–1307.
9. Alfredson H. Good Results with Painful Eccentric Calf Muscle Training for Patients with Painful Midportion Achilles Tendinosis-Implications for New Treatments. J Nov Physiother, 2014, 4: 213.
10. Tumilty S, Munn J, McDonough S et al. Low Level Laser treatment of tendinopathy. A systematic review with meta-analysis. Photomed Laser Surg, 2010, 28:3-16.
11. Cialdai F, Monici M. Relationship between cellular and systemic effects of pulsed Nd:YAG laser. Energy for Health, 2010, 5:4-9.
12. Dundar U, Turkmen U, Toktas H, Solak O. Effect of high-intensity laser therapy in the management of myofascial pain syndrome of the trapezius: a double-blind, placebo-controlled study. Lasers in medical science, 2014 - Springer.
13. Kheshie AR, Alayat MSM, Ali MME. High-intensity versus low-level laser therapy in the treatment of patients with knee osteoarthritis: a randomized controlled trial. Lasers in medical science, 2014 – Springer.
14. Alayat MSM, Atya AM, Ali MME, Shosha TM. Long-term effect of high-intensity laser therapy in the treatment of patients with chronic low back pain: a randomized blinded placebo-controlled trial. Lasers in medical science, 2014 – Springer.
15. Alayat MSM, Elsodany AM, El Fiky AAR. Efficacy of high and low level laser therapy in the treatment of Bell's palsy: A randomized double blind placebo-controlled trial. Lasers in medical science, 2014 – Springer.