High intensity laser-therapy in hand osteoarthritis: a mixed protocol's proposal.

T. Viliani, P. Pasquetti
Agency for Recovery and Rehabilitation, AOU Careggi, Florence, Italy.

ABSTRACT

Hand osteoarthritis (HOA) is a common chronic condition involving one or more joints of the thumb and fingers. Therapeutic approach in hand osteoarthritis must consider local interventions which are useful along the course of the pathology. Laser-therapy (Low Level Laser Therapy-LLLT-) is a possible useful instrumental therapy. High Intensity Laser Therapy (HILT) seems to be more effective than LLLT in pain and disability management of some forms of osteoarthritis, due to its higher intensity and to the depth reached by the laser ray. HILT may be used also in laser-acupuncture.

The aim of this study was to analyze the efficacy of HILT in patients with symptomatic HOA, using a mixed protocol, analgesic anti-inflammatory protocol plus laser-acupuncture.

18 out-patients with symptomatic HOA (II-III Kellgren-Lawrence Grading Index) were enrolled and evaluated by Australian Canadian Osteoarthritis Hand Index (AUSCAN) and Visual-Analogue Scale (VAS), before treatment (t0), after treatment (t1) and after 3 months (t2). The patients were treated with a mixed HILT protocol, analgesic plus laser-acupuncture treatment (4 sessions, once a week).

The patients showed a mean statistically significant improvement between t0 and t1 in AUSCAN Index and VAS, and improvement was found in 83% of the subjects (15/18). The improvement was mostly maintained at follow-up.

The mixed HILT protocol showed good results in a great percentage of HOA patients, with only 4 treatment sessions. We conclude that this kind of HILT protocol could be a good proposal for pain control and for improvement of patient's quality of life.

INTRODUCTION

Although underestimated, hand osteoarthritis (HOA) is an important pathology, with both epidemiological and clinical implications [1,2,3]. Estimates of the prevalence of symptomatic hand OA range from 13% to 26% and are greater in women [1]. Symptomatic hand osteoarthritis affects about 20 % of people over 55 years of age. HOA can be both painful and disabling: common symptoms of HOA include pain, swelling, limited range of motion, stiffness, aching at the base of the thumb. Physical function is compromised too: manual dexterity, fine motor control, and usual daily tasks may be difficult to perform. Osteoarthritis pathogenesis includes the contribution of biomechanical and metabolic factors and genetic [4,5] which gradually lead to articular joint tissues destruction. As the disease progresses, clinical features include joint pain, limitation of movement, tenderness, and episodic inflammation. Especially among the elderly, the impact of HOA on disability is important [5]. Pain control, together with the control of the disability progression are the two main targets of the therapeutic approach. European League Against Rheumatism (EULAR) recommendations for the management of HOA include a combination of pharmacological and non-pharmacological treatments [6]. Treatment options for hand osteoarthritis include oral medications (i.e., NSAIDs, analgesics), steroid injections, splinting, physical or occupational therapy and surgery. Rehabilitation treatments can offer significant benefits to patients with HOA, but research in this field is still poor [7].

Recent reviews analysed the effects of rehabilitative and non-surgical interventions in people with HOA [8,9]. Among physical therapy treatment, Low Level Laser Therapy (LLLT) has been often proposed for pain and flogosis control in osteoarthritis and in HOA too [10]. Nevertheless following the Cochrane Library reviews in LLLT no conclusions could be drawn on the optimal dose, the wavelength and the duration of treatment in osteoarthritis [11]. High Intensity Laser Therapy (HILT), a more recent laser application modality, can be more effective than LLLT in pain and flogosis control, due to its more intense and deeper effects [12,13,14]. In other forms of osteoarticular disease HILT treatment showed good results [15,16,17].

Acupuncture is a treatment with ancient and Eastern roots, but it plays a relevant role in some painful conditions and various kinds of arthritic and rheumatic pain, as reported in WHO documents and in a recent Cochrane Review [18,19]. Laser-acupuncture is a modern way to stimulate acupuncture points and its efficacy has been investigated in Western countries [20,21]. High intensity laser spot may

be used as a needle-like stimulus [22]. It probably works as a heath source to stimulate acupuncture points, in producing anti-nociceptive effects.
The present study was a "before-after" study. The aim was to evaluate the clinical and functional efficacy of the HILT treatment in patients affected by symptomatic hand osteoarthritis.

MATERIALS AND METHODS

Patients. Patients suffering for symptomatic HOA were recruited for this trial from outpatients of the Recovery and Rehabilitation Agency (AOU Careggi, Firenze). Informed consensus was obtained. Inclusion criteria required the presence of symptomatic HOA (following ACR criteria [23]), II-III grade of Kellgren-Lawrence Scale [24] on the radiological evaluation. Exclusion criteria were: therapy with oral anticoagulants, non compliant patients (cognitive impairment or psychiatric disorder), skin diseases.

The patients' evaluation included history and clinical examination, VAS (ref. val. 0-10) [25] and Australian/Canadian Hand Osteoarthritis Index (AUSCAN) [26]. AUSCAN Index (ref. val. 0-60) is a valid, disease specific self-administered questionnaire to assess the importance of pain, joint stiffness and physical disability in patients with osteoarthritis (OA) of the hand. Initial assessment (t0), before treatment, included AUSCAN Index and VAS Scale. The same assessment was repeated after the treatment (t1) and after three months (t2).

Treatment. After the initial assessment all the patients underwent the following treatment protocol: they were treated with High Intensity Laser Therapy, 4 sessions, 1 session a week, for four consecutive weeks. In the same session the patients were treated with a laser-acupuncture protocol, followed by the analgesic anti-inflammatory protocol (see Table I).
Data analysis. Data of patients were compared by Student' t-test.

RESULTS

Eighteen patients with symptomatic HOA, aged 52-73 years, were included in the study. Mean age was 68,4 years. The proportion of male (M) and female(F) patient was 3 M, 15 F . AUSCAN Index values at t0 were 39.6 ± 4.7; VAS scale values at t0 were 6.9 ± 2.2 (see Table II) At t1 the patients showed improvement in the scales points: AUSCAN values changed from 39.6 ± 4.7 to 16.4 ± 3.1 ($p< 0.05$). t1 VAS values were 2.9 ± 1.6, and this difference was statistically significant versus t0: $p< 0.001$ (see Table III). Two patients were lost at follow-up. t2 VAS values were 3.4±1.9 (t2 vs. t1: p = n.s.) . AUSCAN scale also showed little, non statistically significant, variations at t2 vs. t1: 16.4± 3.1 vs. 18.9± 4.3.(p: n.s.) (see Table IV). Improvement was found in 15 patients (83% of the subjects) at t1. At follow-up (3 months) 15/18 (83%) of the patients maintained the improvement. No side effects were found.

TABLE I: TREATMENT MIXED PROTOCOL

HILT treatment protocol: pulsed high power laser, Nd:YAG, λ.1064 nm, 4 sessions, 1 session a week, laser-acupuncture treatment followed by analgesic anti-inflammatory program.

I) Laser-acupuncture was performed on the points 9LU, 10 LU, 11 LU, 3 LI, 4 LI, 3 SI, 8 PC, 3 SJ, 4 SJ, 8SJ, 36 ST, 10 sec/point, 10 Hz frequency, max 30 J /point.

II) The analgesic anti-inflammatory program was articulated in three phases (initial, intermediate and final phase), in manual scansion. Every phase is articulated in sub-phases in which increasing fluency (810-1170 J/cm^2) and decreasing frequency (30-20 Hz) are administered, total energy 1000 J.

TABLE II: GROUP BASELINE CHARACTERISTICS (T0)

PATS. NUMBER	MEAN AGE	SEX	AUSCAN Scale	VAS	KELLGREN GRADE
18	68,4 (52-73)	3M, 15F,	39.6 ± 4.7	6.9 ± 2.2	II 6 pts. III 12 pts

TABLE III: PAIN AND FUNCTIONAL DATA BEFORE AND AFTER HILT TREATMENT

	TO (before treatment)	T1 (after treatment)	T-TEST p-value
VAS	6.9 ± 2.2	2.9±1.6	p<0.001
AUSCAN Index	39.6 ± 4.7	16.4 ± 3.1	p< 0.05

VAS= Visual Analogue Scale (0-10) // AUSCAN = Australian Canadian Osteoarthritis Hand Index (0-60)

TABLE IV: PAIN AND FUNCTIONAL DATA AT THE END OF HILT TREATMENT AND AT FOLLOW-UP

	TO (after treatment)	T1 (after 3 months)	T-TEST p-value
VAS	2.9±1.6	3.4±1.9	p = n.s
AUSCAN Index	16.4 ± 3.1	18.9 ± 4.3	p = n.s

VAS= Visual Analogue Scale (0-10) // AUSCAN = Australian Canadian Osteoarthritis Hand Index (0-60)

DISCUSSION

Recent years investigations agree on functional impact and disability of osteoarthritis of the hand, specially in the elderly, where it is central to daily living impairment. Pain control represents one of the principal tasks in HOA, especially in order to get over acute phases. To date we must register an unsatisfactory response to the various treatments proposed. In the present study we tried to investigate a mixed treatment which joints modern and ancient techniques.

Among instrumental physical therapy the effectiveness of laser-therapy has been often investigated with variable results. Despite a widespread use of this technique, a recent Cochrane review [11] didn't succeed in demonstrating a sure effect of low-level laser-therapy, mainly due to methodological causes of the studies (differences in number of cases, doses and wavelength of laser, etc.). Traditional laser-therapy, which is a low level laser therapy, has got some limits, especially related both to a poor penetration and to a little intensity of the light radiation. Experimental data seem to enhance the hypothesis that high intensity laser therapy may overcome these difficulties, and clinical studies in patients with osteoarthritis confirm its efficacy [12,13,14].

Together with high intensity laser-therapy treatment we combined laser-acupuncture. Acupuncture has nowadays reached EBM for several painful conditions, and its efficacy is accepted by scientific community [19]. Laser-acupuncture is a modern way to stimulate specific points, the same used for needle acupuncture [20]. HILT administered with HIRO.3, with a specific protocol, can work as acupuncture-like stimulation [22]

The patients treated with our mixed protocol improved significantly, at the end of the treatment and at follow-up. This fact indicates a long-acting effect, as the results were maintained at distance. In our study, the treatment showed a great efficacy, achieving a rapid pain control and its maintenance till 3 months. The interesting data is that the results were obtained with a very short treatment, reached in only 4 sessions. May be that the immediate antalgic affect of HILT is maintained by the more slow effect of acupuncture, which is believed to re-equilibrate the whole energetic system of the organism. The hand points treated in fact are considered very important in Traditional Chinese Medicine for hand and fingers pain and stiffness.

A recent systematic review [8] establishes that certain rehabilitation interventions provide benefits in individuals with hand OA, but LLLT and acupuncture alone did not reach evidence for reducing both pain and improving function in hand OA. Laser-therapy resulted effective in improving ROM (Range of Motion) and acupuncture may be effective in pain control.

Nevertheless we tried a new way: our study is a preliminary work, which joints together the modern technology, which is High Intensity Laser Therapy, with a very ancient medical culture, acupuncture. The treatment resulted effective, safe and painless. We don't still know which is the best treatment in HOA patients. Certainly the optimal approach includes a combination of pharmacological and non-pharmacological strategies, tailored to the patient and to the phase of the disease.

CONCLUSIONS

From our data HILT appears to be a good medical instrument for pain control in HOA, with consequent improvement in patient's quality of life. It has a rapid and long lasting effect, it is a non invasive technique and no side effects were reported. The treatment protocol which perform analgesic anti-inflammatory treatment together with laser-acupuncture showed very good results in a few sessions. Our preliminary results suggest that this mixed HILT protocol may be a useful resource in the management of hand osteoarthritis patients

REFERENCES

1. Zhang Y, Niu J, Kelly-Hayes M, Chaisson CE, Aliabadi P, Felson DT. Prevalence of symptomatic hand osteoarthritis and its impact on functional status among the elderly: The Framingham Study. American journal of epidemiology 2002, 156:1021.
2. Barthel HR, Peniston J, Clark M, Gold M, Altman R. Correlation of pain relief with physical function in hand osteoarthritis: randomized controlled trial post hoc analysis. Arthritis Res Ther 2010, 12:R7.
3. Bijsterbosch J, Visser W, Kroon HM, Stamm T, Meulenbelt I, Huizinga TWJ, Kloppenburg M. Thumb base involvement in symptomatic hand osteoarthritis is associated with more pain and functional disability. Ann Rheum Dis 2010, 69:585–587.
4. Pelletier JP, Pelletier-Martel J, Abramson SB. Osteoarhritis, an Inflammatory Disease. Arthritis & Rheumatism 2001;44(6):1237-1247.
5. Caspi D,Flusser G, Farber et Al. Clinical, radiological, demographic, and occupational aspects of hand osteoarthritis in the elderly. Sem Arthritis Rheum 2001;30:321-331.
6. Zhang W, Doherty M, Leeb BF, Alekseeva L, Arden NK, Bijlsma JW, Dincer F, Dziedzic K, Hauselmann HJ, Kaklamanis P, Kloppenburg M, Lohmander LS, Maheu E, Martin-Mola E, Pavelka K, Punzi L, Reiter S, Smolen J, Verbruggen G, Watt I, Zimmermann-Gorska I, Escisit. EULAR evidence-based recommendations for the diagnosis of hand osteoarthritis: report of a task force of ESCISIT. Ann Rheum Dis 2009, 68:8–17.
7. Kloppenburg M. Hand osteoarthritis–an increasing need for treatment and rehabilitation. Curr Opin Rheumatol 2007, 19:179–183.
8. Mahendira D, Towheed TE. Systematic review of non-surgical therapies for osteoarthritis of the hand: an update. Osteoarthritis and Cartilage 2009, 17:1263–1268.
9. Liuzhen Ye, Kalichman E, Spittle A, Dobson F, Bennell K. Effects of Rehabilitative Interventions on Pain, Function and Physical Impairments in People with

Hand Osteoarthritis Arthritis Research & Therapy. 2011;13: R 28 doi:10.1186/ar3254.
10. Brosseau L, Wells G, Marchand S, Gaboury I, Stokes B, Morin M, Casimiro L, Yonge K, Tugwell P: Randomized controlled trial on low level laser therapy (LLLT) in the treatment of osteoarthritis (OA) of the hand. Lasers in Surgery and Medicine 2005, 36:210–219.
11. Brosseau L, Welch V, Wells G, deBie R, Gam A, Harman K, Morin M, Shea B Brosseau L, Welch V, Wells G, deBie R, Gam A, Harman K, Morin M, Shea B, Tugwell P. Low level laser therapy (Classes I, II and III) for treating osteoarthritis The Cochrane Library 2006, Issue 4.
12. Herman JH, Koasla RC: In vitro effects of Nd: YAG laser radiation on cartilage metabolism. The Journal of rheumatology 1988, 15:1818.
13. Romano G., Conti A., Fusi F. Laser-tissue interaction principles: beam penetration in tissue. Energy for Health, 2010,5:10-11.
14. Fortuna D, Rossi G, Zati A, Riannessi D, del Ry S, Paolini C, Piana M, Mondardini P, Masotti L. HILT Therapy nel trattamento dell'artrosi: indagine sperimentale su modello animale. Atti 1°Convegno Nazionale Dominare l'Energia, Report Scientifico Hilt Therapy 2006.
15. Valent A. Risultati clinici nel trattamento della gonartrosi con HILT Therapy. Atti 2° Convegno Nazionale Dominare l'Energia 6-7-8 giugno 2007.
16. Corti L. Fondamenti della laserterapia e e della Hilterapia. Atti 2° Congresso Nazionale Hilterapia, Milano 6-8 Giugno 2007, pag 90-96.
17. Viliani T, Martini C, Mangone G, Pasquetti P. High Intensity Laser Therapy in knee osteoarthritis: comparison between two different pulsed-laser treatment protocols. Energy for Health 2010, 5: 26-29.
18. Santamato A, Solfrizzi V, Panza F, Tondi G, Frisardi V, Leggin BG, Ranieri M, Fiore P. Short-term effects of high-intensity laser therapy versus ultrasound therapy in the treatment of people with subacromial impingement syndrome: a randomized clinical trial. Physic Therapi. 2009 Jul; 89(7):643-52.
19. Manheimer E, Cheng K, Linde K, Lao L, Yoo J, Wieland S, van der Windt DA, Berman BM, Bouter LM: Acupuncture for peripheral joint osteoarthritis. Cochrane Database Syst Rev 2010, CD001977.
20. Whittaker P. Laser acupuncture: past, present and future. Lasers Med Sci 2003, 19 (2):69-80.
21. Baxter GD, Bleakley C, McDonough S. Clinical Effectiveness of Laser Acupuncture: a systematic review. J Acupunct Meridian Stud 2008;1 (2): 65-82.
22. J. L. Zeredo, K. M. Sasaki and K. Toda High-intensity laser for acupuncture-like stimulation. Lasers Med Sci. 2007, 22 (1), 37-41.
23. Altman R, Alarcon G, Appelrouth D, Bloch D, Borenstein D, Brandt K et Al. The American College of Rheumathology criteria for the classification and reporting of osteoarthritis of the hand. Arthritis Rheum 1990;331601-10.
24. Kellgren JH, Lawrence JS. Radiographic assessment of osteoarthritis. Ann Rheum Dis 1957;16:494-501.
25. Langley GB, Sheppheard H: The visual analogue scale: Its use in pain measurement. Rheumathol. Int. 1985, 5: 145-48.
26. Bellamy, J. Campbell, B. Haraoui, R. Buchbinder, K. Koabby, J.H. Roth and J.C. MacDermid Dimensionality and clinical importance of pain and disability in hand osteoarthritis: Development of the Australian/Canadian (AUSCAN) Osteoarthritis Hand Index Osteoarthritis and Cartilage.2002, 10 (11); 855-862.