

Low Level Laser Therapy in Treatment of Stress Fractures Tibia: A Prospective Randomized Trial

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Abstract

Background: Standard treatment of Stress fracture includes rest, compression, elevation and passive stretching. Low level laser therapy (LLLT) has been described in treatment of joint conditions, tendopathies, musculoskeletal pains and dermatological conditions. A prospective randomized control study was carried out to assess efficacy of LLLT in treatment of stress fractures in tibia.

Method: 68 cases were enrolled. 34 each in control and test group. Control cases were treated with placebo and test group with laser-therapy. Complete resolution of pain and tenderness, and return to painless ambulation was taken as end point of therapy in both groups.

Result: The test group showed earlier resolution of symptoms and painless ambulation with fewer recurrence.

Conclusion: LLLT appears beneficial in treatment of stress fracture in this preliminary study. A larger multicentric study is indicated to prove the benefit conclusively.

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Key Words: Stress fracture tibia; Low level laser therapy.

Introduction

Stress fractures are partial or complete fractures of bone caused by repetitive strain during sub maximal activity. The most common site for stress fractures is Tibia. Condition mimicking stress fracture in tibia is medial tibial stress syndrome (MTSS). The treatment of stress fractures involves rest from usual weight bearing activity for about 4 to 8 weeks. Low level laser therapy (LLLT) is used in wound management soft tissue injuries, joint conditions; arthritis, dermatological conditions and acupuncture. A study was conducted to assess if application of low level laser therapy in cases of lower leg pain suspected of stress fracture tibia is beneficial.

Material and Method

212 cases of lower leg pain, unilateral or bilateral, reported to this center over a period of 08 months from March 2003 and Oct 2003. Detailed history regarding onset of complaints, progress and character of pain taken. Examination was aimed at eliciting localized tenderness over tibia, swelling or bony deformity of tibia. All patients were subjected to radiograph of lower limbs looking for radiolucent line in tibial cortex, periosteal thickening or bony swelling. 107 cases were selected with history and clinical examination suggestive of stress fracture. 39 cases had received some prior treatment. These were excluded from the study. The remaining 68 cases, were randomized into two groups of 34 each, Group 'A' the

control group and Group 'B' the test group. All patients were admitted and put on bedrest, restricted mobility, limb elevation and crepe bandage compression. Group 'A' was subjected to placebo in the form of plain red light. Group 'B' was subjected to Low level laser therapy. Endolaser Machine 476 (Fig. 1) of Enraf Noius with a gallium aluminium arsenide probe of 830 nm wavelength utilised. In cases of localized pain and tenderness, contact technique was used where the probe was placed directly on TPs (tender points) and in cases of ill localized pain the scanning technique was used. Energy density applied per sitting was 8 j/cm² and 16 j/cm² for contact technique and scanning technique respectively (Fig. 2). All patients underwent single daily sitting. Recording of Visual Analogue score for pain was done. The score was noted on starting of treatment, daily basis, while on treatment and on stopping the treatment. VA score recorded on day 7 and day 14 after stopping of treatment. End point of therapy in each case was complete resolution of pain and painless ambulation. Data was tabulated and compared. Parameters for comparison were time taken for complete resolution of pain and return to painless ambulation. Recurrence of symptoms after conclusion of treatment and full ambulation was also evaluated.

Results

All cases were male of young age (mean 22 yrs) . In Group 'A' mean age was 22 yrs (range 18-24) while in Group 'B' mean age was 22.5 yr (range 19- 24). Long distance running over hard surface was the event most commonly associated with onset of complaints (84% cases). Short sprints in ballgames

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like football, handball and jump events were other causes as seen in Table 1. Pain on weight bearing associated with tenderness over tibia was the universal complaints in all cases. Palpable bony swelling suggestive of underlying cortical reaction was seen in (25% cases) (Table 2). Follow up of patients while on therapy indicated that there was faster resolution of complaints and early return to painless ambulation in the group treated with laser vis-a-vis group undergoing placebo. In Group 'A' 15 cases remained symptomatic at the end of 21 days of treatment while in Group 'B' 03 cases remained symptomatic (Fig. 3). Statistical analysis of variance (ANOVA) and students T test. $p < 0.05$ was considered significant. Our data comparison however showed a p value = 0.10 which is statistically not significant. Follow up of patients who had become asymptomatic with treatment 19 cases in Group 'A' and 31 in Group 'B', revealed that on return to premorbid level of activity, there were fewer number of cases reporting with recurrence of symptoms in the laser-treated group than in the placebo group over an observation period of 14 days (Table 3). Data analysis revealed p value < 0.05 , hence significant.

Discussion

Stress fractures results from the application of abnormal muscle stress on a bone and is associated with new strenuous or repeated activity. Tibial stress fractures are often confused with medial tibial stress syndrome (MTSS) accounting for about 50 per cent of all stress fractures in athletes [1]. Stress fractures are preceded by periostitis. Microscopically there is a rapid focal



Fig. 1 : Endolaser 486 machine with probe



Fig. 2 : Technique of use : localisation of tender point (TP) and application of probe to it

Table 1

Event associated with onset of complaints

Event	Number of cases	Percentage of total
Running on hard tarmac	57	84%
Parade/drill	50	07%
Ball games	04	06%
Jump event	02	03%
Total	68	100%

Table 2

Presentation

Presentation	Number of cases	Percentage of total
Pain leg	68	100%
Bony tenderness	68	100%
Bony swelling	17	25%
Soft tissue swelling	11	16%

Table 3

Follow up of patients after cessation of therapy and return to activity : Number of cases with recurrence of symptoms

Day from conclusion of Rx	Group A		Group B	
Day 07	5/19	26%	3/31	09%
Day 14	9/19	47%	5/31	16%

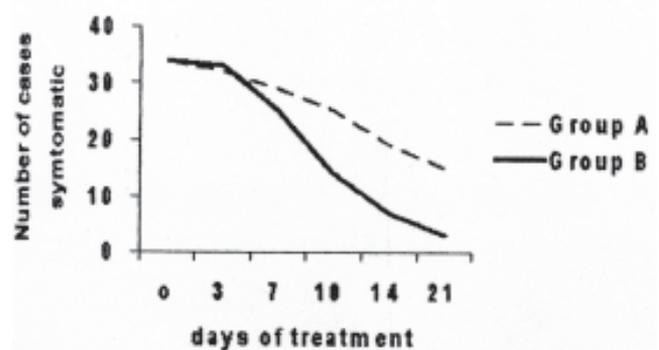


Fig. 3 : Trend of resolution of symptoms on treatment

circumferential periosteal resorption with formation of small cortical cavities. Simultaneously denser, weaker lamellar bone is laid down along lines of stress at a slow rate. The net effect is a transient weakening of the cortex which may actually rupture with continued stress [2,3]. Stress fracture tends to be more common in runners. Stress fractures comprises about 10% of all sports injuries, and between 4.7-15.6% of all running injuries [4]. In our study , long distance running accounted for maximal number of cases. Typical symptom of tibial stress fracture is 'crescendo pain'. Other clinical indicators include nocturnal pain , extremely tender focal bony tenderness over tibia and positive

provocative manoeuvres (pain on application of vibrating tuning fork / heel thump/ leg hop/ local ultrasound at 2.5 to 3 MHz). Diagnostic test for stress fracture include: radiography with cone down view; triple phase bone scan and MRI. Radiograph is unreliable in early diagnosis where MR imaging is better modality as it detects early changes of osseous stress injury. Bone scan is extremely sensitive but suffer from false positive rates of up to 11-23% [5,6]. All our cases were subjected to plain radiograph of affected and opposite limb and findings suggestive of stress fracture was seen in 23 cases (39%).

Low Level Laser Therapy (LLLT) is a form of photobiomodulation. The Arndt Schultz law of biomodulation infer that low dosages of photonic energy will stimulate (photostimulative) and higher dosage will inhibit (photoinhibitive) these biological processes [7,8]. This phenomenon has been extensively utilized and studied for analgesic, antiseptic, antispasmodic, anti-inflammatory and antineuralgic action [9,10]. Therapeutic effects of laser are both wavelength and dosage dependent. Wavelengths between 820-840 nm have an extremely low absorption rate, thus allow deep penetration window. Number of publications support the effectiveness of 830nm gallium aluminium arsenide (Ga Al As) diode laser in treatment of musculoskeletal injuries, neuropathic pains, rheumatoid and osteoarthritis [9,11,12,]. Studies demonstrate if the desired effect of an initial treatment is that of pain attenuation, an inhibitory dosage (8-16 j/cm²) would be indicated and if the desired effect is that of tissue repair, then the required dosage per treatment point will generally fall within the optimal therapeutic window between 0.5-5 j/cm² [13,14].

Authors have not come across any study documenting use of LLLT in stress fractures. But studies have shown definite benefit in delayed bone union and in healing of experimental bone fractures [15,16]. In our series, we found that addition of LLLT in treatment protocol for stress fractures, resulted in faster resolution of symptoms and signs and that the patients could be ambulated earlier. There were fewer incidence of recurrence when the patients returned to pre morbid level of activities. Statistically the difference proved insignificant between the two treated groups, it is explained by the fact that the number of cases in the group were small and follow-up period short.

In our study, the diagnosis and the end point of treatment have been clinical parameters only and substantiating the same on objective criteria such as appearance of callus on serial follow-up radiograph remains pending.

The major criticism of low level laser therapy to date has been the inability of practitioners to reliably replicate results obtained by other individuals. With laser treatment

parameters recorded in terms of output power, beam spot size, treatment time and wavelength, particular treatment can usually be replicated in vivo and in vitro, not only with the same laser unit but with any laser configured appropriately [17].

This preliminary study has demonstrated the potential of low level laser therapy in treatment of these injuries. A large multicentric study is desirable to prove the role of LLLT in earlier healing of stress fractures.

References

1. Detmer DE. Chronic Leg Pain. *Am J Sports Med* 1982;8(2): 141-3.
2. Ilahi OA, Kohl HW. Lower Extremity morphology and alignment and risk of overuse injury. *Clin J Sports Med* 1998; 8(1) :38-42.
3. Geslin GE, Thrall JH. Early detection of Stress fracture using 99mTc Polyphosphate. *Radiology* 1976;15: 683-4.
4. Roub LW, Gumerman LW, Hanley EN. Bone stress radionuclide imaging perspective. *Radiology* 1978;132(8) :431-3
5. Spitz DJ, Newberg AH. Imaging of stress fractures in the athlete. *Clin Nucl Med* 2002; 27(7): 475-8.
6. Batt ME, UgaldeV, Anderson MW. A prospective controlled study of diagnostic imaging for acute shin splints. *Med Sci Sports Exerc* 1998 ;30(11):1564-71.
7. Baxter GD In *Therapeutic Lasers : Theory and Practice* . Edinburgh, Churchill Livingstone press 1994;6:12-34.
8. K Smith. The photobiological basis of low lever laser radiation therapy. In: *The Science of Photobiology 2nd Edition* .New York, Plenum Publishing Co.1994:156-82.
9. OshiroT, Calderhead RG. In *Progress in Laser Therapy Vol 1* .Chichester, UK, John Wiley & Sons publications 1991 : 12-23
10. Trelles MA, Mester A. Low power laser therapy: Experimental and clinical Data. *Scandinivian Journal of Acupuncture and electrotherapy* 1987; 11(2): 80-100.
11. KudohinomataK, Okajima K, etal. Effects of nm Ga Al As Diode laser radiation on rat saphenous nerve Na K ATPase activity examined. *Laser Therapy* 1989;1:63-8.
12. Toya S, Oshiro T, et al. Morphological demonstration of Low Reactive Laser Therapeutic pain attenuation effects of the GA Al As Diode laser. *Laser Therapy* 1994;1:239-61.
13. Mester AF. Laser therapy in wound healing, a review. *Laser Therapy* 1989;1:7-17.
14. Mester AF. The blostimulative effect of low-level laser therapy or lung standing crural ulcers using Helium Neon laser, helium Neon plus infrared lasers and non coherent light : preliminary report of a randomized double blind comparative study. *Laser Therapy* 1994;1:97-8.
15. Glinkowski W. Delayed union healing with diode laser therapy (LLLT). Case report and review of literature. *Laser Therapy* 1990;2:107-10.
16. Glinkowski W. Rowinski J. Effect of low incident levels of infrared laser energy on the healing of experimental bone fractures. *Laser Therapy* 1995;7:65-8.
17. Calderhead RG. Watts a Joule : on importance of accurate and correct reporting of laser parameters in low reactive level laser therapy and photobioactivation research. *Laser Therapy* 1991;3:177-82.