

# Two-Year Study Of Disease Modifying Effect Of Low-Level Laser Therapy (LLLT) On Deformity Correction In Degenerative Hand Joints Affecting The Distal Inter-Phalangeal Joints (Heberden Nodes)

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## Abstract

### Introduction

Hand osteoarthritis frequently affect the distal inter-phalangeal joint (DIPJ) manifested as Heberden nodes and with time can produce joint deformity. Recent studies on hand OA (osteoarthritis) demonstrated the importance role of ligaments in pathogenesis. This forms the rationale of this long prospective clinical study to assess the clinical efficacy of low-level laser therapy (LLLT) in correction the DIPJ deformity

### Materials and Methods

This prospective study consisted of 4 patients with 6 affected hands with Heberden nodes and concomitant DIPJ deformities. All subjects received LLLT treatment from GaAlAs semiconductor lasers on a twice weekly basis for not less than 48 weeks. All subjects refused the use of sham light source as controls. Treatment failure is defined as either failure of pain relief or failure to correct the DIPJ deformity. Exclusion criteria included subjects with rheumatoid arthritis or those suffering from trauma. All subjects in this prospective cohort had refused operative intervention for their hand deformity.

### Results

All deformities of the DIPJ were corrected in the 6 affected hands treated in the 4 subjects at the end of 48 weeks treatment by LLLT. All subjects had their hand pain subsided at a mean of 12 weeks. There were no defaulters as all subjects were satisfied with the clinical response obtained.

### Conclusion

LLLT if properly administered for not less than 48 weeks can correct DIPJ deformity associated with hand OA manifested as Heberden nodes

## INTRODUCTION

It has previously been reported by the author that low-level laser therapy (LLLT) can have disease modifying effect on degenerative knee joints [1]. It was further reported by the author previously that LLLT can have good clinical efficacy in control of upper extremity pain of the shoulder [2]. The present clinical case series of 4 patients all have so-called "Heberden Nodes" on both hands during initial presentation

as chronic hand pain and deformity. This clinical case series reveal the success of LLLT in not only tackling the problem of hand pain in these subjects, but also after prolonged administration of not less than 48 weeks lead to resolution of the initial deformity affecting the distal inter-phalangeal joint (DIPJ) of the hand which is easily visible clinically.

## MATERIALS AND METHODS

## **Two-Year Study Of Disease Modifying Effect Of Low-Level Laser Therapy (LLLT) On Deformity Correction In Degenerative Hand Joints Affecting The Distal Inter-Phalangeal Joints (Heberden Nodes)**

The prospective cohort study period spans from 2018 to 2022, consisting of patients attending wellness pain center, a tertiary referral specialist centre. The male:female ratio was 0:4 and the mean age was 58 (range 55 to 68). All the patients also had serial blood tests that ruled out rheumatoid arthritis. LLLT was provided by a GaAIA's semiconductor device emitting 810 nm wavelength, 5.4 J per point, and power density of 20 mW/cm<sup>2</sup> was used and the duration of application of LLLT over the relevant site was 360 seconds for every affected hand administered on a twice weekly basis without the use of other oral medications. All patients consented to receive the treatment for at least 48 weeks and have serial clinical follow up. No other physiotherapy treatments were administered other than FDA approved LLLT devices. The use of control by sham light source was objected by most subjects and thus sham light irradiation was not employed. All patients had minimum follow up of 2 years to assess the long-term clinical results in terms of pain level, as well as whether there is any resolution of the DIPJ deformity from osteoarthritis of the small hand joints.

### **RESULTS**

All subjects completed the LLLT treatment of not less than 48 weeks without side effects. Treatment failure is defined by failure to obtain clinical remission of chronic hand pain that necessitated medications, other physiotherapy, or even surgery. In this study, there were no defaulters, and 4 out of 4 subjects demonstrated good clinical responses to LLLT with no more hand pain after a mean follow up of 12 weeks (Range: 8 to 15 weeks). Fig 1 illustrates a typical patient with typical Heberden nodes of the DIPJ with deformity mainly located at right hand index and middle fingers DIPJ at initial presentation. Fig 2 illustrates the same hand after 48 weeks LLLT treatment, notice the previous DIPJ deformity in index and middle fingers had largely disappeared, although there is early appearance of deformity occurring this time at proximal inter-phalangeal joint (PIPJ) of the middle finger, as well as DIPJ of the ring finger.

**Figure 1**



At the last follow up, there was no pain in all patients, and all subjects were satisfied to know not only were there clinical response, but also positive clinical result in correction of DIPJ deformity.

**Figure 2**



## DISCUSSION

Heberden nodes of the hands is of common occurrence in daily clinical practice. Traditionally, they have been treated with non-steroidal anti-inflammatory medications, and physiotherapy, as well as sometimes surgery for DIPJ deformity. This study represents the first clinical study to show that LLLT can in fact correct the DIPJ deformity if the treatment is provided for not less than 48 weeks.

Unlike traditional physiotherapy machines, LLLT confers biomodulation effects such as improvement in microcirculation, and upregulation of several genes involved in energy metabolism and oxidative phosphorylation which stimulates an increase in adenosine triphosphate production, which in turn regulates other cellular processes leading to normalization of biological functions at a cellular level [3]. This healing process takes time and thus underlying the need of continual treatment for not less than 48 weeks as in the current study.

LLLT can enhance bony healing by various mechanisms including an increase in BMP2-induced phosphorylation of the Smad 1/5/8 pathway [4] as well as stimulate BMPs-induced expression of type 1 collagen, osteonectin, and osteocalcin mRNA [5] besides improving bone mineralization [6]. This study showed LLLT can enhance not only the healing of bones, but healing of deformed small hand joints in the hand if administered for not less than 48 weeks.

Notwithstanding the above discussion, one might wonder why it is possible for LLLT to be able to correct the DIPJ deformity, given the fact it is quite widely believed that osteoarthritis (OA) mainly affected cartilage and bone. A recent groundbreaking research on early OA of hands [7] confirmed the important role of ligaments in hand OA using high-resolution magnetic resonance imaging together with histological examination. The same applies for more complex lower limb joint such as the knee in a recent study

[8] confirming the importance of intra-articular ligament degeneration having a key role to play in cartilage and bone destruction in more complex joints such as the knee joint. It is therefore concluded the fact that the current study confirmed LLLT can improve joint deformity in hand OA most likely works by dint of its anti-inflammatory and healing effects of the ligaments (and its attachment sites) of the distal inter-phalangeal joints of the hand.

## CONCLUSION

The administration of low-level laser therapy for 48 weeks was shown to be effective in enhancing the healing of degenerative small hand joint diseases with Heberden nodes. LLLT was also demonstrated to be able to eradicate not only the chronic joint pain, but also at the same time correct the accompanying deformity of the distal inter-phalangeal joints of the hand.

## References

- 1/ Ip D (2015) Does addition of low-level laser therapy (LLLT) in conservative care of knee arthritis successfully postpone the need for joint replacement? *Lasers Med Sci* Dec 30(9): 2335-9
- 2/ Ip D (2015) Two year follow up of low-level laser therapy for elderly with painful adhesive capsulitis of the shoulder *J Pain Res* 8:247-252
- 3/ Hashmi JT [2010] Role of low-level laser therapy in rehabilitation *PM R* Dec 2(12 Suppl 2): S292-305
- 4/ Hirata SC, et al (2010) Low-level laser irradiation enhances BMP-induced osteoblast differentiation by stimulating the BMP/Smad signaling pathway *J Cell Biochem* 111:1445-1452
- 5/ Favaro-Pipi et al (2011) Low-level laser induces differential expression of osteogenic genes during bone repair in rats. *Photomed Laser Surg* 29:311-317
- 6/ Ling LC et al (2010) Synergism between Wnt3a and heparin enhances osteogenesis via a phosphoinositide 3-kinase/Akt/RUNx2 pathway *J Biol Chem* 285:26223-26224
- 7/ AL Tan et al (2006) Combined high-resolution magnetic resonance imaging and histological to explore the role of ligaments and tendons in the phenotypic expression of early hand osteoarthritis. *Ann Rheum Dis* Oct;65(10): 1267-72
- 8/ Gundula Schulze-Tanzil et al (2019) Intra-articular Ligament Degeneration is Interrelated with Cartilage & Bone Destruction in Osteoarthritis. *Cells* Sep;8(9):990

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