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# Hyperacusis and other Inner Ear Disorders are improving after irradiation with Photobiostimulating LASERS.

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## Abstract

Several theories about pathophysiological mechanisms involved in hyperacusis, as an inner ear disease, have since long been discussed and described in literature.

Authors[1,2] discuss errors in regulating processes of amplification of hearing cells. Other theories about the disorder are based upon central sound processing at a subcortical level. There are also discussions about the role of specific substances that could activate neurotransmitters that could increase both nervous system cell activity and sound perception.

Recently, several studies and research reports on Photobiostimulation and especially Low Level Laser Therapy (LLLT)[3,4] have opened a new window for treatment where cellular metabolism and other molecular mechanisms, involving ATP as a neurotransmitter[5], provide grounds for a new medical paradigm and new therapies. Up to now, chronic and neuropathic pain have for many years been disorders successfully treated[6] with Laser Therapy.

Regarding chronic hyperacusis, in a study Zazzio[8] reported obvious and undeniable improvements on pain thresholds for all patients who were treated with a multi-therapy protocol which was based upon laser therapy. Patients evaluated in long-term follow-up had an improvement level 9.5 dBHL larger than patients evaluated instantly after finished therapy.

## Objectives

The objective of our study was to confirm photobiological effects and some molecular mechanisms formulated by Tiina Karu[4,7] and other photobiomodulation researchers[8].

Our prospective study on 57 patients who were suffering from hyperacusis and several other inner ear disorders such as Morbus Ménière and tinnitus was conducted using laser therapy[3,4], based upon photobiostimulation.

All 57 patients in our study were suffering from different grades of hyperacusis, measured through pure tone signals The UCL (Un-Comfort Levels) were measured for audio-frequencies ranging from 125Hz to 8KHz.

The patients' ages varied from 18 to 81 years with an average of 47.4 years and a median of 45 years. There were 31males and 26 females.

## Methods

Two types of semiconductor lasers emitting 650nm and 808nm light wavelength (red and infra-red ligth irradiation) were used.

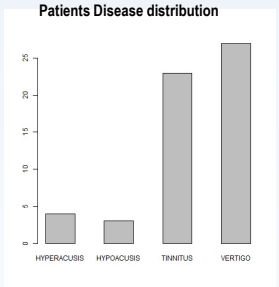
Therapy Protocol

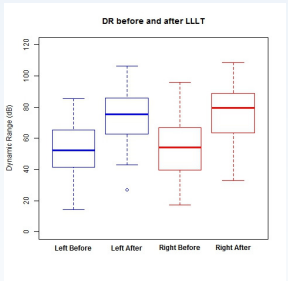
The standard protocol for all patients was at the begining of therapy 12 sesions, twice a week. Some patients had more sessions than that. Irradiation time/dose was adapted to each patient according to individual anatomy, side effects and other detectable reactions. All patients were evaluated two months after the start of therapy

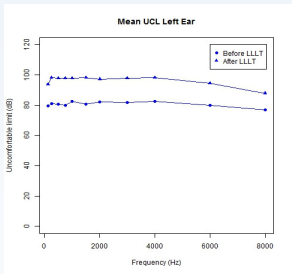
Data:

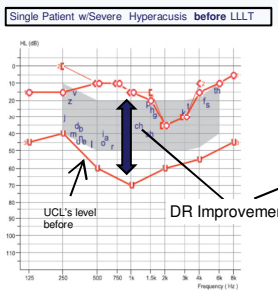
- Laser Power: Continous Output was 100mW for 650nm and 300mW for 808nm.
- Irradiation spot area at a distance of 25mm from the laser probe was around 0.20-0.25 $cm^2$ for the 808nm laser and around 1 $cm^2$ for the 650nm laser.
- The laser probe tips were placed inside the meatus acusticus, at a 15-17mm distance from the tympanic membranes.
- The total laser power dose applied each session was adjusted between 144-540 Joules (J) with the 808nm laser and between 54-120 J for the 650nm laser. Each patient was dose irradiated according to individual factors and treatment progress

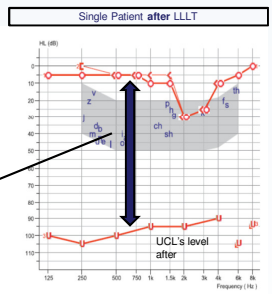
## Auditory Index before/after Therapy



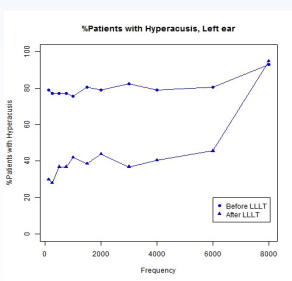




DR Improvement




## Results

Index variables PTA, mean UCL, mean DR and percentage of patients suffering from hyperacusis: All showed an improvement on hyperacusis levels after LLLT. The PTA (Pure Tone Average) was in average 5 dB lower after LLLT. Average UCL (Un-Confort Level) levels were on average 16 dB higher after LLLT. The DR (Dynamic Range) augmented 20 dBHL in average and the POH (Percentage of Observations regarded as Hyperacusis) decreased by 30-50 %.

About these index variables of patients with hyperacusis - all showed a difference in levels after LLLT, and a report data[9] shows that all observed changes are statistically significant, implying improvements in certain hearing parameters and symptoms of patients treated with laser photo-therapy/light irradiation.

## Conclusion

The results confirm that hyperacusis as a disorder more susceptible to a poor cochlear condition than of other known neurophysiological processes. After therapy all patients had an improvement or a total recovery both on their hyperacusis and often also on other inner ear disorders such as tinnitus, Ménière's disease and vertigo.

We are absolutely sure that photobiological effects and Laser Photo-Therapy (LPT), involved in the cochlear homeostasis, opens a new approach for the management of hyperacusis and other inner ear disorders.

Future studies will asses the long-term benefits of LLLT for the treatment of inner ear diseases.

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