

## Usage of Laser in Controlling the Evolution of Face Structures, an Approach of "Laser-Orthodontics", In Vitro

**Mhd Azhar Ibrahim Kharsa, DDS, PhD (Ortho)<sup>1-5</sup>**

PhD & Medical Board of Orthodontics

<sup>1</sup>Has a Ph.D. in Orthodontics domain, of the University of Medicine and Pharmacy "Victor Babes"

<sup>2</sup>Scientist Fellow of the "American Society for Laser Medicine and Surgery"

<sup>3</sup>Fellow of the "World Federation of Orthodontists"

<sup>4</sup>Fellow of the "Arab Orthodontic Society"

<sup>5</sup>Medical Board of British Commonwealth of Saint Christopher

### Abstract

**Background and Objectives:** This is an endeavor to use Laser in controlling the evolution of the face structures, especially the condyle and the mandible bone. The aim of that study is to try to use laser in future for treating patients whose facial structures are predisposed to deviation in evolution and in growth. As a potential solution in prophylactic orthodontics, as "Chin-Cup, face-mask and head-gear" for instance, laser might be, one day, a potential substitution for controlling the evolution of those facial structures.

**Study Material and Methods:** Three groups of Hamsters, each one comprises of three animals.

Group A: Is the normal evolution group, or the surveillance group.

Group B: The three hamsters of that group have been exposed to Chin-Cup, with moderate power on each side, about 450g. Per side.

Group C: That group is the lased group, as the condyles of that group have been exposed to light energy of a diode laser. A red light at 650 nm with energy of 90m W/cm<sup>2</sup> had been used to perform light dosages 10 - 15 J/cm<sup>2</sup>.

**Results:** A long term study extended to seven months has shown an eminent slowness in the growth of lower jaws on both groups B and C, relatively to group A. The importance of such approaches is in the possibility of future usage of laser in controlling the evolution and growth of facial structures on humans.

**Keywords:** In Vitro; Chin-cup; Diode laser; Laser-Orthodontics Therapy

### **Introduction:**

Orthodontics is one of the important domains that interests in human evolution and growth. Perhaps the success in producing light energy laser (that is not deleterious or "harmless") could enhance the insertion of laser into the practice of Orthodontics. The importance of that "light energy" laser is in slowing down the evolution and growth of some specific structures. That idiosyncratic characteristic of the facial structures in human may push forward towards new approaches of trying to control their progression, and to manipulate the "growth process" either to cope with overgrowth, or to treat the undergrowth possibilities [1-10].

### **Materials and Methods**

Nine animals are the subjects of that study. Those hamsters are divided into three groups as for comparison. The first group "A" is a surveillance group as it has been conserved for spontaneous growth, non-treated neither by chin-cup, nor by laser. The group "B" is the one whose three hamsters were exposed to chin-cup with force averaged of about 450 g. per side. Such a force is so efficient in hindering or slowing the normal growth of the lower jaw [11]. The group "C" is the lased group, a diode laser is used on both sides of lower jaws of the three hamsters, during the period of the experiment. A red light at 650 nm with energy of 90m W/cm<sup>2</sup> had been used to perform light dosages 10 - 15 J/cm<sup>2</sup>. As for all those nine animals, length of lower jaws had been sized on intervals of each month to compare the efficiency of each method on both groups "B" and "C". The purpose of such measurements is to perform an

average of changes. The average of changes is important, as to measure the quantity of changes that are fulfilled by laser in comparison with conventional method that is here the Chin-Cap. The nine hamsters are on the same stage of growth and should submit to equivalent circumstances.

### **The Influence of Laser on growth**

Unfortunately, the contemporary usage of laser is still often "ablative". On high-energy laser, and high dosage laser treatment, it's normal to see necrotic foci onto the exposed arena [12-22]. However, gradually light dosage of laser treatments, and low energy laser are drawing more attention, especially because of their non-ablative impact on vital cells. The influence of laser at 650 nm is not necrotic especially on the joint of lower jaw, or the temporomandibular joint TMJ. Anyway, despite of the impossibilities of performing such studies on humans, the importance of such studies is on the future perspective to progress a future substitute. To study the influence of laser with low energy and slight dosage it's recommended here to analyze its impact on the cartilage growth of the condyle of the mandible. The condyle in general comprises of multiple strata that are subsequently proliferated and deposited [11,12]. To understand the normal growth in facial structures, it's desirable to study the Condyle Cartilage strata.

The Condyle Cartilage strata are:

- The fibrous capsule.
- Prechondroblasts, and skeletoblasts.
- Cartilaginous matrix
- Functional chondroblasts
- Hypertrophied chondroblasts.
- Calcified cartilaginous matrix
- Degenerating chondroblasts
- Individual osteon

- Osteoblasts
- Lamellae of endochondral bone [11,12,14]

According to chin-cup studies [12] the influence of chin-cup happens on the aspect of Prechondroblasts stratum.

However, the influence of low laser energy laser is slightly different as it mainly happens on the so-

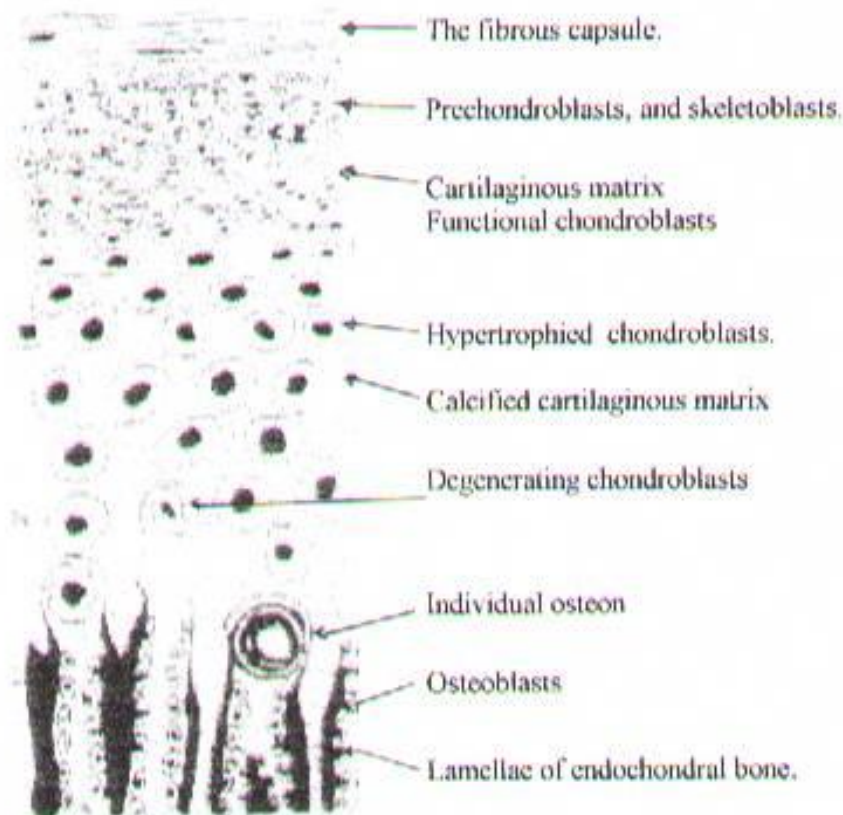
called zone of growth and zone of maturation, or in other words the prechondroblasts, cartilaginous matrix, hypertrophied chondroblasts, and the calcified cartilaginous matrix (Figure 1).



**Figure 1:** The therapy with chin-cup.

The fibrous capsule, the prechondroblasts, and skeletoblasts form the so-called Zone of Growth. While the cartilaginous matrix, functional chondroblasts, hypertrophied chondroblasts and the calcified cartilaginous matrix form a so-called Zone of Maturation. Whereas the degenerated chondroblasts form the so called: zone of erosion.

The final terminology on that aspect of mandibular condyle is the zone of ossification. It's observed that after the exposure to low energy laser the number of the cells on the strata of zone of growth and zone of maturation lessens. Consequently, the evolution of newly ossified layers would decrease; in other word, the growth would be delayed (Figure 2).



**Figure 2:** Strata of the mandibular condyle.

## Results

According to that experiment on hamsters, in group "B where chin-cup had been used for seven months", the crux of retardation in mandible growth had been on the beginning of the experiment. The highest percentage of jaw delay in growth had been on the first month 42%. Perhaps this exaggerated percentage is pertinent with the preliminary coercion of the jaw, which pushed the condyle back. Nonetheless, the delay in growth of that group B had been decreased to only 8% on the final days of the seventh month of the experiment. ( $P > 0.05$ ) In contrary to group B, the group C "the three hamsters treated with low energy laser" had the most delay in growth on the seventh

month. The values of delay in growth had been so modicum on the first month 5%, gradually, by using the red light at 650 nm with energy of 90m W/cm<sup>2</sup> performing light dosages 10 -15 J/cm<sup>2</sup>, the growth had been retarded to about 20% relatively to group A on the final days of the seventh month. ( $P < 0.05$ ). The importance of group C values is the absence of "onslaught" climax. The advantage of insertion of such a technique of laser on group C had been apparent in the regulation of delay in growth of the hamsters, as retardation in evolution had been increased continuously from 5% on the first month to about 20% on the final steps of experiment (**Table 1**).

**Table 1:** The Average of Changes of values of growth: "in groups B and C" relatively to A per month. SD means here the Standard deviation.

Months	Group B "Chin-Cup"		Group C "low energy laser"	
	AC	SD	AC	SD
1	42	0.084	5	0.011
2	25	0.069	7	0.013
3	22	0.047	9	0.014
4	25	0.036	13	0.012
5	20	0.026	15	0.016
6	13	0.061	17	0.025
7	8	0.064	20	0.022

## Discussion

The experiments can elicit a potential substitution to the therapy with chin-cup in future. Nonetheless, to perform such experiment in vivo, it's crucial to have more profound knowledge about the side-effects of the light energy laser therapy. The importance of such an experiment is in expressing the hindering influence of laser on normal growth. It's also so vital to know the threshold, or the "stamina" that could the organism tolerate laser without any irreversible degenerations. Therefore, the importance of usage of laser therapy, as for non-ablative therapies, is paramount dependant on finding an acceptable threshold that enables the therapist to use laser without potential destruction, or necrotic changes. The influence of laser energy on strata of tissues is still somehow vague, as it's important to find in future the possible "receptors" or the tissues of higher "response" to laser, as something like this if "it could be existed" would be a high leap within that domain.

## Conclusion

According the experiments, Laser may be used in future for regulating the growth of facial structure, as a potential substitution to the convention means that are used now.

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