Comparing Between Two Lights Curing of Dental Restorative (Laser and Halogen) by Using Physical Parameters

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Abstract

Light sources and light curing techniques for composite resins have improved remarkably. Aragon Ion Laser (AL) have been introduced for curing dental composite and to overcome drawbacks of the conventional quartz-tungsten halogen lights (QTHs). The aim of research to study the mechanical properties (Hardness & Degree of cure) of composite material after light curing by different sources (Halogen and Laser). These feature were including hardness and depth of cure in both curing unit (laser argon and halogen light) in different exposure (10 , 20 , and 30) by using two of fillers material swissTEC and composan LCM types . The(216) samples have been prepared and dividing into (6) groups , micrometer are used to measuring the depth of cure according to (ISO 4049/2000) . Hardness test are made by Vickers hardness testing with diameter (6mm) and thickness (2mm) of samples, The results of the depth of cure appeared the resin composite by aragon laser light curing is greater than halogen light with about (0.05).In (10 sec) depth of cure (DOC) of halogen in 2.072, but in laser argon is2.640, 20 sec halogen is 3.047 , and in aragon laser is 3.090 of swissTEC type but for composanLCM for (10 sec) depth of cure halogen is 2.25, laser argon is 2.530, 20 Sec halogen is 2.577 , but in aragon laser is 2.921 , the result values of (DOC), hardness tests are increased with increasing the exposure time, also show the depth of cure and hardness for swissTEC type larger than composan LCM. The properties of the composite enhance better when laser is used as a cure unit in a comparison with the halogen light.

Introduction

The amalgam has been used in dentistry and it is still in many ways a suitable restorative materials. Its advantages are strength , relatively easy clinical handling and low cost. Disadvantages are lack of adhesive properties to tooth substance and its non aesthetic character .(1)

The first acrylic filling material prepared in England was developed by S. A. Leader in 1944. This was an early attempt to improve adhesion to tooth structure. It was soon found that high polymerization shrinkage , wear , discoloration and leakage were major problems and dentists were returning to the use of silicate cements [1].

For the early resin composites, polymerization was initiated by mixing of two pastes. One paste contained an activator, such as a tertiary amine, which was used to split the initiator, usually benzoyl peroxide, which was found in the second paste. In the early I970 Ultraviolet (UV) light-activated resin composites became available. The UV light, with a wavelength of approximately 365 nm, splits benzoin methyl ether into free radicals, without the presence of tertiary amines, thus starting the polymerization. In this way, only one paste of composite was necessary and polymerization would not start until it was activated by the UV light. Unfortunately, there were some serious drawbacks attached to the UV light-curing systems. Because of the spectral distribution of UV light it may cause damage to the eye and soft tissue burns, the depth of cure achieved with UV light-curing ,units was limited due to high light absorption in the resin composite. However the benefits of having one paste resin composites, which sets on demand by the curing light, gave rise to the development of visible light activated resin composites. In modern light-cured resin composites, the most common photo initiator is camphoroquinone, it is sensitive to light with a wavelength in the blue range, approximately 420 to 490 nm with a peak at 468 nm. After irradiation, it works as a Source of free radicals for the curing process[2].

Light Curing Units

Light-curing units can be divided into different groups according to the light source and/or curing mode used. As mentioned above, the first light source used for resin. composite polymerization was UV light, which was produced from a mercury discharge lamp. These units were replaced in the early 1980s by the Quartz Tungsten Halogen light units (QTH), in these curing units the bulb is filled with halogen, iodine or bromine gas, and contains a tungsten filament, when connected to an electric current the tungsten filament glows and produces a very powerful white light, which is filtered to the range of blue light (400-500 nm). This matches the sensitivity of the photo-initiator used in the resin composite. Heat generation is a major disadvantage of QTH units and increases with increasing radiation time [3], other drawbacks are limited lifetime of the bulb and degradation of the reflector and filter over time. The visible light units are both cheaper and also less damaging for the eye and tissues compared to UV. In the mid 1990 a new type of high intensity light-curing unit was introduced. In the plasma arc (PA C) light unit, the light is generated by high voltage between two tungsten electrodes, separated by a small gap. The resulting spark ionizes the gaseous environment (Xenon) and creates a conductive gas known as plasma. This light curing unit was able to generate power densities more than (2000 m W \cm²) . The Argon Laser has also been proposed as a curing device providing a very high irradiance optimized for initiation of polymerization. A serious drawback with the argon laser was its cost, and argon lasers were not commonly used [4]. In the late 1990s a new light source was introduced , the light emitting diodes unit (LED). In LED devices, junctions of doped gallium nitride semiconductors (p-n junctions) are subjected to an electric current and blue light is generated [4] .Compared to QTH curing units, LED curing units have a narrower wavelength spectrum and require no filters[5]. For most units the spectrum is in the range of 440-490nm , close to the efficient wavelength for activation of camphoroquinone. The LED curing units have several obvious advantages compared with the QTH units. The diodes have a life-time of more than 10.000 hours compared to the 40-100 hours effective life-time of QTH bulbs, and there is no degrading of bulb, reflector or filter over time which results in reduction of curing effectiveness. They produce less heat than the QTH curing units and therefore most of the LED units do not need a fan. The first LED units showed far lower power densities than QTH curing units. The semiconductors were aligned in arrays or small groups of LED's limited by the surface area of the light guide. In newer generations of LEDs, the conventional diodes have been replaced by large surfaced emitting LED chips, and power densities up to(900 mW/cm²) are now possible [5], the great advantage with LED compared to other light sources is its energy efficiency. the relation between power input and light output. For QTH the energy efficiency is 0.7%, for PAC 0.2%, for Laser 0.02% and for LED 13% [6] . Because of this high energy efficiency of the LED and the absence of a fan, the LED units are not as energy consuming as QTH units. Therefore, they are often battery-operated.

Sample

This study is made on light curing compound material from (Composan LCM) kind and swissTEC, which sum bit to qualities of comprehensive goodness system (ISO 4049 ⁄ 2000) and it is not poisoned from the compounded material which in it the filler materials are very tiny in size and various (Micro Hybrid composite). The manufacturing company (PROMEDICA Domagkstr 24537 Neumunster \ Germany)

Samples Preparation

In this study , three kinds of manufactured matrix from stainless steel which are made by the researchers (Saadi Shirshab Thiab and his group), each kind from these matrixes is used to prepare the suitable samples for the examinations which will operate and they are :

The first design will be like a cylindrical hollow in diameter (6mm) and length (8mm) , this design is used to prepare the special samples for measuring the depth of curing ,The second design will be a cylindrical hollow in a diameter (6mm) and length (10mm) . With using of iron stick in a diameter (6mm) and length (8mm) , it is entered in to the hollow to prepare samples in thickness (2mm) , this design is used to prepare the special samples for examining the hardness and the crystal compound .

Light Curing Units

In present study we using two light curing unit

1.Halogen Light

In this study it has been used the source of Halogen Light which creates a spectrum of wave lengths lie in blue range from the visible spectrum which considered as a lightening source used in operating the light hardness for the compounded material thst use the Halogen equipment which has light stress (250 mW) . Location : College of dentistry , University of Babil . It was the source of Halogen light from the kind Coltolux ®50 (Coltene GmbH Fischenzstrasse 39 D- 78462 Konstanz Germany) .

2.Argon Ion Laser

It was used the source of light Aragon Ion Laser from the (Multiline) light kind which creates a spectrum from the wave lengths (457-514 nm) lie in the blue range that be narrower (narrow bundle of wave lengths) than the spectrum which is created by the source of Halogen light which is used in light curing operation .The argon ion laser for light which is used the kind (Laser Physic ⁄ USA) ، (Ser NO. 0205351) ، out put power (168 mW) Location : university of Technology – College of Engineering –Laser Department

HardnessTest

The hardness is the resistance of surface of material to indentation that effected by many factors like fractional size of fillers , type of resin and degree of polymerization. After curing light , the existence of non-participating monomers in the reaction leads to shortening values of hardness. The hardness of organic fillers affects the hardness of the material in general [7] Manhart J. explained the relation between the fractional volume of the fillers and surface hardness, and found that the composite having a higher fractional volume than fillers has a higher surface hardness[8]

For a photo curing play important role in the process of hardening, as well

as for light sources used in the study source of halogen light is widely used, as he works in a wide range of wavelengths but this is trapped between (410-500 nm) that effective in by curing optical process, which is absorbed by the material prefix (comphoroqiunone). Tables (1, 2) shows values of surface hardness (Mpa) of the three groups of the prepared samples while figures (1, 2) shows diagram of averages of degree of cure (VHN%) of two type of filler which results from dividing average of hardness of the inner side by the average of hardness of the exposure side multiplying by (100%) as in the following equation :

Degree of cure = (Inner side ⁄ Exposure side *100%) ……….(3-1)

Noting value of hardness we find that hardness of the composite increases by time. Moreover the table (1) and table (2) shows that hardness composite by argon laser is a little higher than (H) . That what conclusions of researches declared. [8,9]

The argon laser has power to polymerize the composite better than (H) , therefore hardness gets higher, this little difference in hardness results from the less amount of intensities used with argon laser than (H). Conclusions of this study does not agree with [10]

The micrometer (PHYWE HOREX ⁄ ID – NR 0905114321 meter ISO – GWE ⁄ Germany) use to measure the depth of cure . Which considered the scraping technique or consideration removemont by the system (ISO 4049 ⁄ 2000). This technique stands on removing the incomplete cure part after making the curing operation ,thickness is measured by the micrometer which divided in two refer the depth of the lightening cure.

The halogen light source and laser argon are different in terms of a mechanism to generate and display light spectrum emitted (not all wavelengths of light emitted from these sources suitable for optical hardening process imbricated). The light wavelength between the (410-500nm) is more effective as the spectra distribution of the light sources with the effective range (410-500 nm) varies greatly. The depth of cure is considered the most important characteristic to specify the variety of the compound material by several methods, the important ones are hardness test , IR spectrum , and ISO scraping technique [40] . It has been used according to the goodness system 4040 ⁄ 2000 ISO . Where the all samples of both sources of light in a periods of exposure (10, 20, and 30 Sec) were measured according to criteria (ISO 4049 ⁄ 2000) because they all give depth ofcure more than (1.5 mm) which represents half of length measured by micrometer.

As for the way of testing depth of cure through ISO , it is scraping underlying soft paste of the lower part of the sample and measuring the remaining length divided by (2) , because the hardness of the lowest part of the remaining material often equal (0) .

Researches also show that (50%) of the remaining length has (80%) of the hardness of the sample surface when the ratio of the hardness of the lower surface to the upper surface is (80%) it gives a suitable cure as many researches showed [40] . It is obvious from the tables (3, 4) that averages of values of depth of cure increases by time and for both type of light cure, as exposure duration is considered an important factor for all properties of the sample because increhgrdsalasing exposure duration allows big number of monomers converse. Thus polymerization enhances and values of (DOC) of the composite after being by argon ion laser becomes higher than values of (DOC) of the composite after using (H-light) because of many reasons like argon laser emanates from spectrum of wave lengths are considered an ideal amount of polymerization a composite with high direction, it can go deeper than what conventional sources reach, and that laser does not result in losingpower of distance unit as it is in the conventional sources, this agremental with [9,10,11]

The laser light differs from the halogen light because the ray of laser moves in parallel lines and creates in a narrower band width, as well as , it has a high directionality, these characteristics enable it to get through the compound in a big way, to get the required properties and a big exposure display [12,13,14,15]. Figures (5,6) showed that DOC of swissTEC is significantly higher than composan LCM

Conclusions

By the results that were obtained conclusion the following :-

1-In argon laser the hardness of the composed material becomes better.

2- Increasing intensities and time of curing are very important factors to improve polymerization of both swissTEC and comopsan LCM

3-The relationship between curing degree and depth of cure are the extrusive.

4-When used halogen light source in the curing light process with a duration of treatment (10 and 20) observe the physical and mechanical properties of the composite are not good so it needs to curing time biggest (30,40, and 60) To improving the properties of composite

5-It turns out that the hardness be the biggest at the time of 30 seconds when using laser argon or halogen light

6-The hardness in exposure side greater than inner side when used the laser and halogen for two type swissTEC and composan LCM

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Table (1) : Shows averages of hardness in (Mpa) unit of inner and exposure sides and degree of cure of swissTEC type

Curing Type	N	Exposure side	Inner side	Curing degree
10 Sec H	6	120.974	105.908	87.56
10Sec Laser	6	129.796	116	89.37
20Sec H	6	155.308	140.333	90.35
20Sec Laser	6	160.703	150.32	93.35
30 Sec H	6	160.930	150.335	93.41
30Sec Laser	6	174.420	165.570	94.38

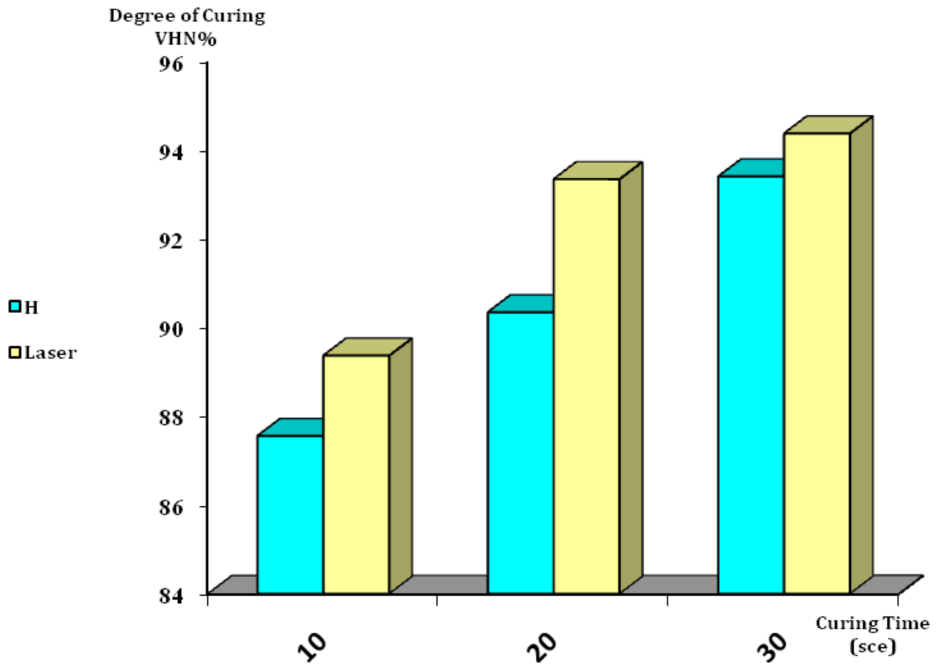

Figure (2): relationship between degree of cure and depth of cure of swissTEC type

Table (2) : The averages of hardness in (Mpa) unit of inner and exposure sides and degree of cure of compsoan LCM type

Curing Type	N	Exposure side	Inner side	Curing degree
10 Sec H	6	78.36	68.05	89.11
10Sec Laser	6	76.93	70.05	91.05
20Sec H	6	82	75.31	91.84
20Sec Laser	6	81.88	78.31	95.63
30 Sec H	6	82.2	78	94.78
30Sec Laser	6	84.80	82.05	96.75

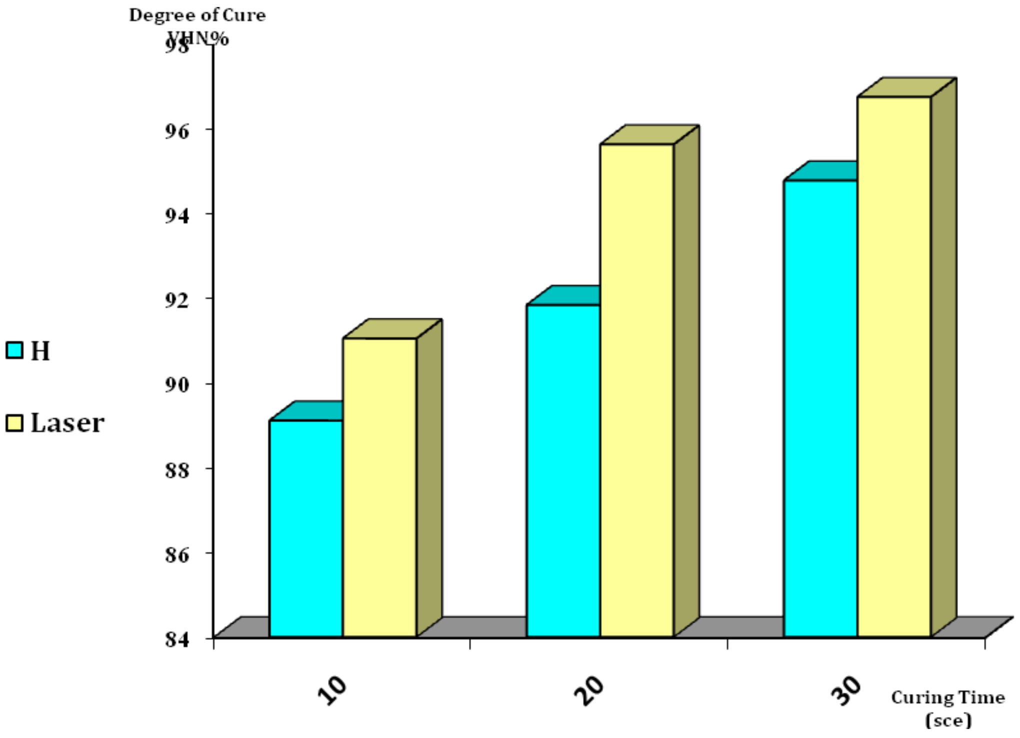

Figure (3) : The averages of hardness in (Mpa) unit of inner andexposure sides and degree of cure of composan LCM type

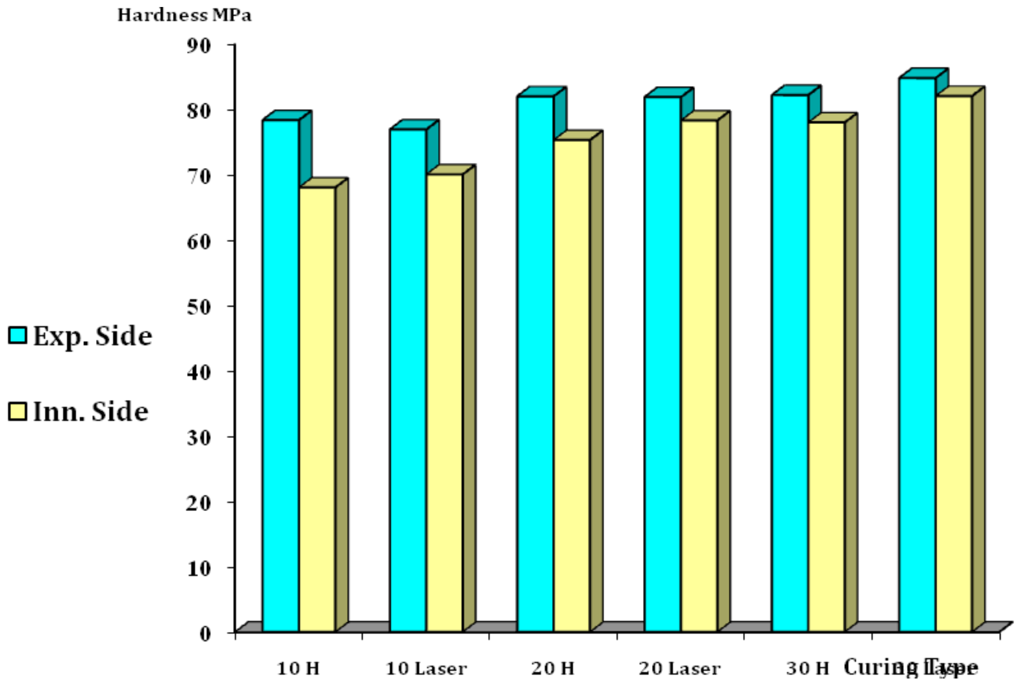

Figure (4): Relationship between degree of cure and depth of cure of composan LCM
Depth of Cure Measurement

Table(3) The ranges value of the depth cur ofswissTEC type

Curing Type	Number of Sample	DEPTH OF CURE DOC(mm)
10s H	6	2.072
10s Laser	6	2.640
20s H	6	3.047
20s laser	6	3.090
30s H	6	3.072
30 Laser	6	3.541

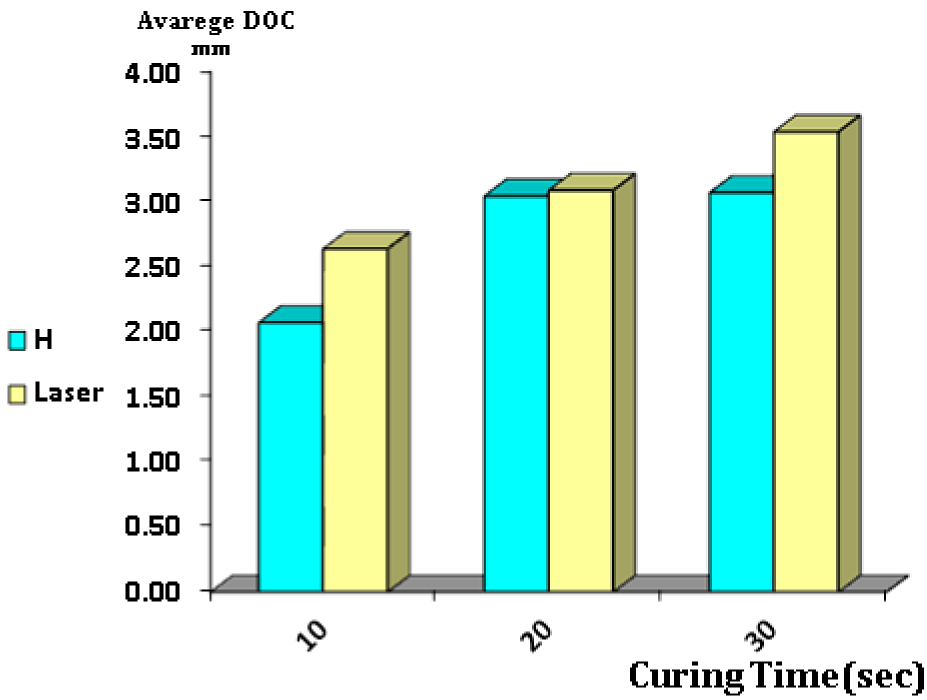

Figure (5) :The ranges value of the depth of cure of swissTEC type, where H represent to Halogen light of cure

Table(4) :The ranges value of the depth cure of composanLCM type, where H represent to Halogen light of cure .

Curing Type	**Number of Sample**	**DEPTH OF CURE DOC (mm)**
10s H	6	2.025
10s Laser	6	2.530
20s H	6	2.577
20s laser	6	2.921
30s H	6	2.742
30 Laser	6	3.010

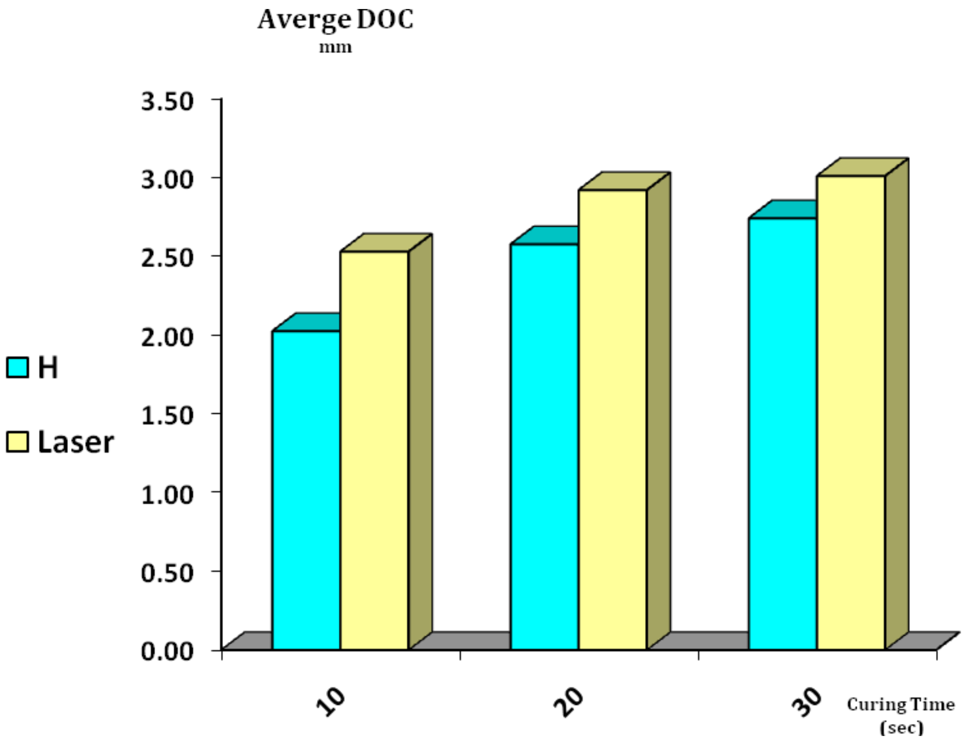

Figure (6): The ranges value of the depth of cure of Composan LCM type.