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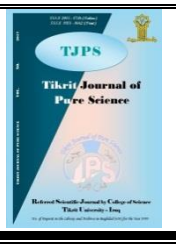

Study the effect of diode laser on the properties of dental composite

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Abstract

In this study anterior filling was used type of G-aenial and used in the restoration of teeth, then conducted a study and divided into four groups of the first sample, which is the group A, which was irradiated by laser and then hardened by Light Curing then irradiated with laser and the third sample C, which was irradiated with Light Curing, and the laser on the sample at the same time and the fourth sample D The original samples are not exposed to irradiation (control) Based on the filling specifications The sample was prepared cylindrical and dimensions (10 × 6mm) to be used in a number of Synthetic measurements such as x-ray diffraction analysis, electron microscopy scanner and some important mechanical properties such as hardness and wear. The results showed X-ray diffraction that the components of A, B, C and D aggregates gave emitted precipitation and a thin crystalline state clear all forms of x-ray diffraction. It was found that the XRD test of the B group showed a significant increase in the intensity of the material in the G-aenial filler and is indicated by the laser effect clearly after light therapy and laser irradiation.The results of the SEM examination of group B in the case of Light Curing and laser hardening showed clear homogeneity and better atomic distribution compared to other studied groups.

Introduction

The composite resin photovoltaic is a Sunni reactive substance composed of three main components: the filler, the resin mold, the bonding material as defined by Philins[1]. The fillers are composite resin materials, although their content is less than 50%. The fillers are prepared by grinding or refining the quartz crystals to obtain particles of sizes between (100-100) µm. Silicon from sub-granular volume to (0.04-0.02) µm to small fillers by high heat process.

The resinous mold is used for monocrystalline monomers, which are the aromatic or aliphatic acrylates in most optical fillings. The BIS-GMA molecule is most likely used, but it is also often used in dimethylcritite. On high levels of filler material and for the production of a name that makes it suitable for clinical application. These monocrystals can be of methyl methylcrylate but are often of the type TCHDMA (Trichlorethylene ethylene dihydrate). When added to BIS-GMA, Practical [1]. Although it is possible to use titanics and zircones as bonding agents, the most common is the use of organic selenium. The gonorrhea contains the selenol groups that can be associated with the selanols on the filler surface by forming the cycloxan bond. Methacrylate groups of organic gonorrhea form a form Of the covalent bonds with the resin when polymerizing and thus accomplishing the binding process. The composite resin is a type of composite material consisting of a combination of two or more components that differ in form and do not dissolve one another

In dentistry, it refers to resin-based materials with a meta-kerlate-hardened thermally stimulated thermally stimulated polymer with at least 50% capacity of the filler molecules. [2]. and the composite in the restoration process requires high skill and accuracy in the work, which must be the age is not wet (dry) during the process of filling the tooth with composite to ensure adherence to the age otherwise the process will change without obtaining the required result 'And when the composition of the workplace must be In the case of softness to be easy to deal with also just exposure to blue light with the wavelengths are often designated (470nm) [3]. The composite material

hardens to be a hard filler. Often the light penetrates only (2-3) mm in the material. If a thick layer of filler is placed on the tooth and because the light does not penetrate completely, the inner layers of the filling remain partially soft or not completely polymerized. On the penetration of free structural units that lead to the break of the links and then the damage of the tooth to add the filling are in the form of layers of mobilization so that the deepest is the first layer and then the second layer until the completion of the necrosis fully and the thickness of one layer of (3-2) mm In order to ensure that they are fully crystallized by highlighting them before adding the second layer [4]. The development of composite resin was seen with the progress of polymerization polymerization as direct feed material. The development of photovoltaic materials began in late 1950 and early 1960. Brown began his experiments on epoxy resin, which is supported by filler molecules. However, the lack of epoxy system properties such as slow and color change has increased Brown's enthusiasm to research and benefit from the properties he will obtain from collecting acrylates with epoxy. In the early sixties has been discovered resin fillings of resin composite and is accompanied by a tremendous momentum propaganda gives it a touch of magic that can restore the affected teeth to the nature of color and beauty wonderful except resistance, durability and continuity in the mouth for a long time [5]. In the early 1980s, two types of treatment were developed. The first type is the treatment of visible light, which leads to the creation of a treatment that uses blue light at the end, and the second type of light for advanced treatment is the halogen quartz bulb [6]. This device has wavelengths of visible light spectrum, allowing for increased penetration of the treated light and also the light energy of the resin compounds [7]. That UV treated light was replaced by halogen light treatment.
In the 1990s and the early 21st century, optical fillers developed significantly, with adequate pressure tolerance for use in the back teeth [3].

Theoretical side

Light Curing

The light Curing has many advantages for optical resin restoration because of the significant role it plays in achieving the physical properties of the optical charge to achieve the best results. The incomplete polymerization leads to reduced wear resistance of the wear, high water sorption, It also results in poor color stability [8].

Laser

Semiconductors like the diode are smaller, lighter, cheaper, more durable, and the latest generation of lasers, producing many waves depend on doping that are continuously or pulse visible and infrared. All wavelengths of laser diode are absorbed into pigmented tissues. Dental tissues have a low absorption capacity in the diode laser. Soft tissue surgeries can be performed even in the enamel, cement and ivory areas with high levels of safety. Laser beams used in dentistry are part of the non-ionizing beams of the electromagnetic spectrum. Depending on the wavelength and energy as well as the target tissue type, they can cause stimulation or tissue cut [9]. According to the Sulieman et al. Study on the use of diode laser to whiten the upper and lower front teeth, energy levels that reach (W2) do not pose a danger to the vitality of the pulp while the temperature is higher than the critical temperature 5.5 C) is thought to lead to irreversible injury Where the pulp vitality [10]. The results of the study of Klunboot et al. On the effects of diode laser temperature on pulp tissues during teeth whitening showed that in a diode laser with a wavelength of 808nm, the force of 1.5 (W) is the highest strength in the change in pulp temperature is still below the safety range of (5.6) ° C, and can also be effective for teeth whitening [11]. Umana and others used a laser diode (810-980) nm with radiation capacity (0.8, 1, 1.6, and 2W) to treat molars, from 1mm distance for 10 sec. The results revealed that laser applied with a capacity of 0.8 and 1W can be used to seal ivory tubes and are harmless to pulp health [12] . According to a study conducted by Liu et al. On the treatment of hypersensitivity to ivory by 980nm laser diode, the laser beams with the energy outputs of (2W) lead to the sealing of exposed ivory tubes effectively without creating any significant morphological change in the pulp and odontoblasts [13].

Mechanical properties

The relationship between the stresses and forces depends on the resistance of the polymers that begin to break or distort or affect the mechanical properties of the material. There are different types of tests used to find these properties, including hardness and wear behavior, and these properties depend very much on the microstructure of the polymer, Granular and crystalline structure and the content of the second phase such as the content of impurities and the composition of elements and the arrangement of atoms in the crystalline network .

Hardness

It is the property of material that retains its surface under the influence of external force and can also be defined as the material resistance to penetration and scratching by another material. The hardened and diamond is often used as a stitching tool because of its high strength. The hardness properties also depend on the strength of bonding between the molecules and atoms. With the material and the degree of smoothness in the material and increase the value of hardness as the atoms are coherent and stronger binding. Filled objects have less penetration resistance than pore-free objects. There are several ways to test for hardness, depending on the stitching tool being tested:

1- Shore hardness test (no stitches, but a sklearscope)
2. Brinell hardness test
3. Rockwell Hardness Test

4. Rebound Ball test
5. Knoop hardness test
6. Vickers hardness test

Shore Hardness

It is the material resistance of the distance division and the elliptic scale was defined by Albert Ferdinand Shore in 1920 which developed a device to measure the rigidity of the Shore. The term "thermometer" is often used to refer to measurement as well as the same instrument, usually as a measure of hardness in rubber, polymers and plastics.

The Shore instrument was initially called the rigidity test later in the 19th century and was called the Durometer scale. This name is now called the Hardness of Shore [14] .

Wear

The phenomenon of wear and tear is the removal of part of the polymer between two surfaces, which have a relative movement. It is also known as the collapse of surfaces with each other of the fractions and also known as loss of material from the surface of the polymer when it is loaded and under the influence of the relative movement. Because of different mechanical wear and tear occurs depending on the alloy and the geometric shape of the moving shapes and on the polymer type and operational conditions [15] .

Method of Work

There are many types of optical fillings for teeth. A German-type G-aenial filler was selected from Vita-Zahnfabrik, and was studied and divided into four groups for testing such as laser effect and light Curing These are laser-irradiated samples before they are light Curing and Light Curing samples before laser irradiation and samples were irradiated with Light Curing and laser on the sample at the same time and samples are the original samples not exposed to irradiation (control) .

The mold is made of a material which is a paste of synthetic rubber containing a concentration of silicon and it is highly viscous during handling (Protesil) from the Italian industry of Vannini and the yellow color is a very soft material and hardness during hardening and is cross when adding material (Protesil catalyst gel) and red color and when adding this red substance to the yellow material, the process of solidification and become a mold prepared for the preparation of samples. 40 samples were prepared by placing the filling material inside the mold radius of 10 mm and height 6 mm. It was hardened by laser phototherapy once again and the laser was again inside the mold and then removed from inside the mold in the form of rigid filling as in Fig1 and use a type laser epicx and a wavelength of 840 nm and power 0.2 watt and 10 min time.

Measurement and Examination

Analysis of XRD

After X-ray diffraction was used to determine the phases and distribute them in the fill prepared in the study. In this study, an X-ray diffraction device manufactured in the Netherlands by (PHILIPS 1965160) and the achievement of the Braggs Condition and the diffraction occurs in crystalline materials, which is using a smaller wavelength or equal to the weak distance between the crystalline levels in the retina of the material and the following equation [16]

$2d\sin\Theta = n\lambda$ … (1)

d: the distance between the crystalline levels in the material lattice.

Θ: diffraction angle (deg).

n: Integer number equals (1).

λ: Wavelength used in the scan of X-ray

Scanning electron microscope (SEM)

After the preparation of the sample, the samples are ready for accurate installation tests using the scanning electron microscopy microscope (SEM) of the US company of Inspect F50 in the central service laboratory at the College of Education for Pure Sciences Ibn Al-Haytham- University of Baghdad. The electronic microscope scanner is very technical in the calculation process The ratio of the weight and weight components in the vehicles and determine the quality of the vehicles and their contents through the analysis of the results and the ability to take the microscopic image at a very high magnification up to (10^5) times and to any point on the surface of the model .

Wear Testing

The wear and tear test was performed using a pin-on-Disc device (Wear and Friction Monitor ED-201), an Indian origin indicated , located in the laboratories of the Department of Mechanics, Faculty of Engineering, University of Tikrit. To measure the height of wear and tear in units (μm) mediated by a sensor attached vertically to the hand of the sample holder. It senses the high wear and tear of the model during the test period, transmits the reading directly to a precise digital scale, and measures the friction force between the sample and the disc by means of a horizontally linked sensor On the arm the friction force generated between the disc and the model is felt by units (N) Direct reading to another precise digital scale The device also contains a timer to measure the duration of the test accurately and stop at the end of the specified period and contains a load of weights used during the test period

Measurement of Wear

The steel disc was cleaned before testing and then calibrated using standard samples to determine its accuracy. The rotational velocity of the disk was then measured using a digital tachometer (HQRP) of Chinese origin, followed by the variables . The friction coefficient was calculated by relationship (2)

$$\text{Wear rate} = \frac{w1-w2}{2\pi\, rnt} \quad \ldots\ldots(2)$$

W1 = first weight

W2 = the second weight

π = radius

n = number of courses

r = rotational velocity

Shore Hardness

Hardness Testing. The Shore-D (Shore-D) Shrink Thermometer is used to measure the hardness of a thermosetting polymer, a device that resembles an elcometer compass and contains a needle in the middle. (DIN 53505) and 50N (5 K Pa) for the hardness. Shore (D Shore) At least ten readings have been taken at different locations of the sample surface, The sample used for this test is diameter (10mm) and high (6mm).

Results and discussion

X-Ray Result

Figure (2) shows that there is a significant increase in Intensity. The curves indicate a clear crystal growth during the reflected peaks of the laser-irradiated sample and then the LED. The figure (3) shows the occurrence of some displacements and change in the angle positions (2ɵ) for the peaks of the locator from their positions and this indicates the occurrence of homogeneity between the atoms and crystalline regularity. It is noted from Figure (4,5) that the intensity of the sharp elements is lower than the previous figure (3). However, this indicates a better crystalline uniformity that occurs when the treatment is done by optical therapy followed by irradiation by laser.

Scanning electron microscope (SEM)

The images were taken in a SEM device for samples with a fixed thickness of 50 µm and showing Figure (6-A) at the magnifying force of the electron microscopy scanner (SEM X790) the sample is shown after laser irradiation. It may be observed from the form that there is a remelting process and an overlap between the elements of this sample with some interlocking pones In Figure (6-B) and in the magnifying force of the scanning electron microscopy (SEM X960), which shows the irradiated sample with phototherapy and laser irradiation, there is a homogeneous and clear interference between the sample contents and the lack of pores between them.

This apparent result is fully consistent with the results of x-ray diffraction (XRD) shown in Figure (4) which showed a clear sweet growth in increasing the height of the axle peaks. The (6-C) form and the amplification of the SEM X620 for the laser beam and the hardened sample (LED) in the sample itself showed that there were cracks between the components of the sample with a defect of the surface (Defects) (6-D), there is a clear homogeneity and overlap between the granules of the materials used and the amplification force of the scanning electron microscope (SEM X620) .

Percentage ingredients for the studied samples

Through the graphs in Figs (7, 8, 9 and 10) the distribution of the elements for all the samples that appeared in G-aenial fill was obtained through SEM technique. Figures and tables (1, 2, 3 and 4) show a rise or decrease in the component ratios due to the type of treatment that has been performed, Treatment, whether laser or phototherapy, or both has an effect on the disappearance or the appearance of some elements indicating the effect of the type of treatment on the analysis of the elements used in the filling G-aenial but generally experimental results showed the presence of elements in the fill of O, Na, Al, Si, K, Ca, Nb, Cl, Mg, C. The analysis of elements of the G-aenial sample was also obtained using the SEM technique, which was determined to be the composite of the reactants. There was a slight difference between the expected weight and the observed weight.

Mechanical Hardness (Shore)

Statistical data were analyzed using the SPSS program. The T-test was used to analyze the difference between two groups, the Duncan Multiplexing Test and the samples were divided into four groups (A, B, C, D), as observed in Table 5,6 (Figure 11,12) showed differences in the values of the hardness of the shor, and noted that when light Curing and then laser treatment of group B, they gave great values different from those without irradiation or laser irradiation or both. Through these values of mechanical hardness, B group with higher values are fully consistent with XRD X-ray results and microscopy examination SEM, which showed clear homogeneity, systematic distribution of elements, and increased element strength during SEM and XRD

Wear

The results of Table 7,8 and Figures (14,15) showed differences in the values of wear and tear. He noted that when light Curing and then laser therapy for group B gave small values different from those without irradiation or irradiation or both. Through these values of mechanical wear it was observed that the weariness of group B with the lowest values is fully consistent with the results of XRD and examination Which showed clear homogeneity, systematic distribution of elements, and increased element strength during SEM and XRD .

Conclusions

1. By conducting G-aenial tests and analyzes for groups A, B, C, D, we can deduce the following results

2. The results of the X-ray examination showed that the components of A, B, C and D aggregates gave emitted precipitation and a crystalline crystal clear state of all X-ray diffraction.

3. In the XRD test, it was found that the B group observed a significant increase in
Intensity of G-aenial filler material This is an indication of laser effect clearly after phototherapy.

The results of the SEM showed clear homogeneity and better aromatic distribution of group B in the case of light therapy and laser hardening.

5 - G-aenial SEM showed a rise and decrease in the ratio of elements through treatment and the type of treatment used by laser or optical therapy or both has had an effect in hiding and showing some elements and this is an indication of the effect of the type of

treatment on the analysis of the elements used in G-aenial filling.

6. The mechanical hardness values of the B group (laser-cured and laser irradiated) gave higher values than the D group values of the original non-irradiated sample. This is in line with the results of the XRD and SEM tests, which showed a clear homogeneity Regular distribution of elements and increased element strength.

7. The mechanical wear and tear values of the B group (light-treated and laser-irradiated) have low values compared to the D-group values of the original non-irradiated sample. This is in line with the results of the XRD and SEM tests which showed a clear homogeneity Regular distribution of elements and increased element strength.

Figure (1) Template used for sample preparation (6 x 10mm)

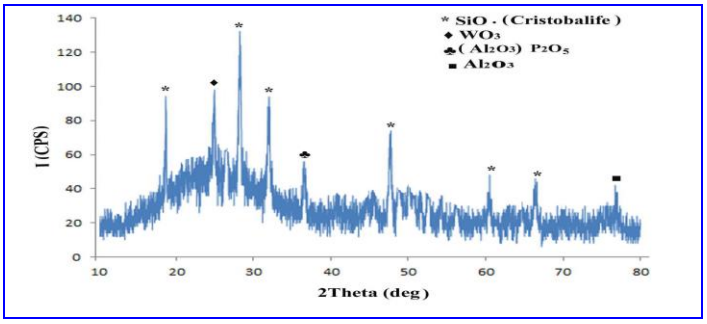

Figure (2) Results of X-ray diffraction analysis of the laser irradiation sample and then the LED hardener

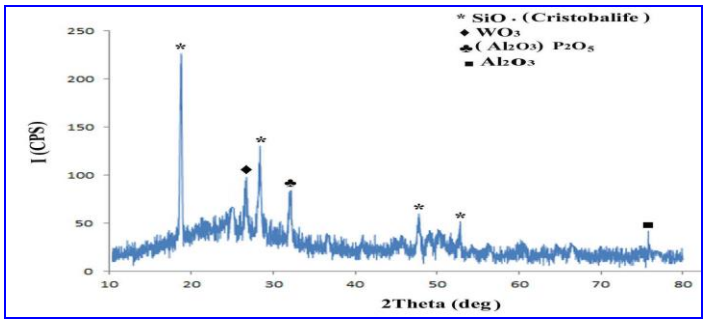

Figure (3) Results of X-ray diffraction analysis of the sample LED hardening and then irradiation

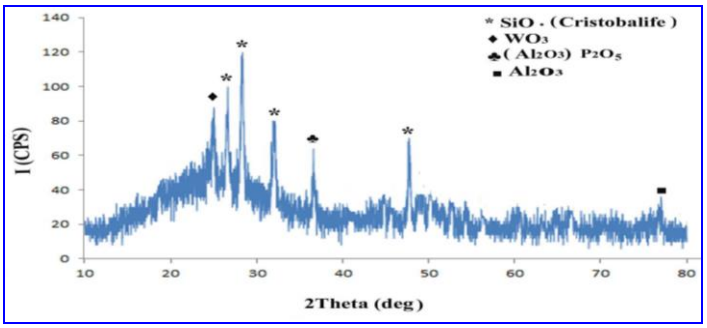

Figure (4) The results of X-ray diffraction analysis of the laser and LED sample on the sample at the same time

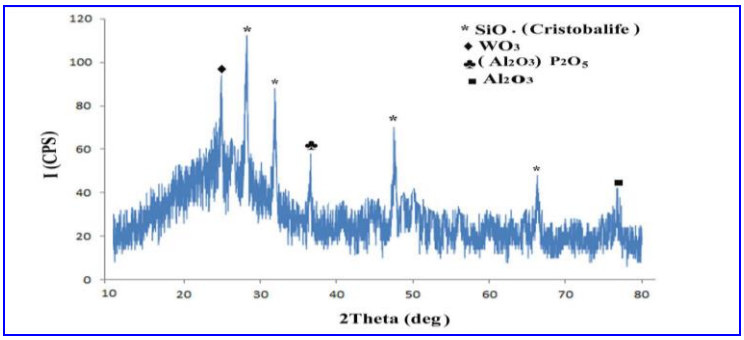

Figure 5 Results of X-ray diffraction analysis of the original non-irradiated sample (control)

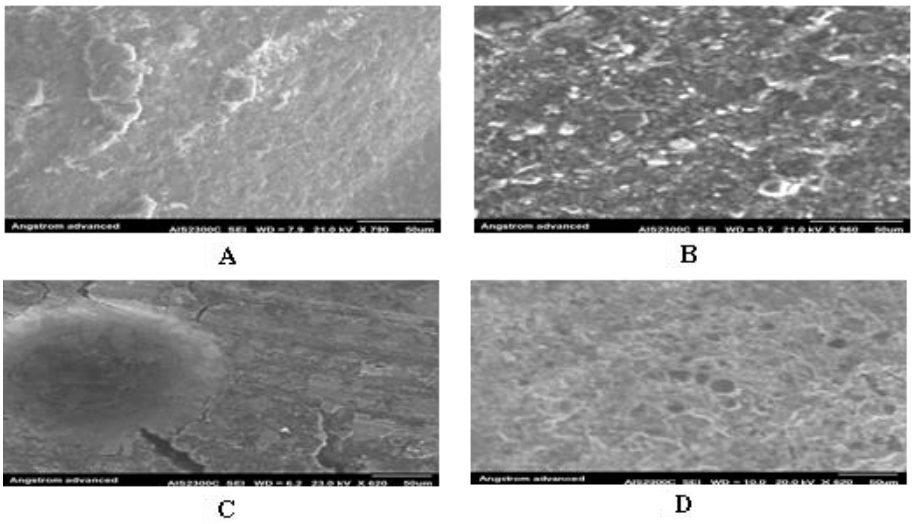

Figure (6) Image of microscopy of 50 µm thickness for amplification force of the scanning electron microscope (SEM for groups A, B, C, D)

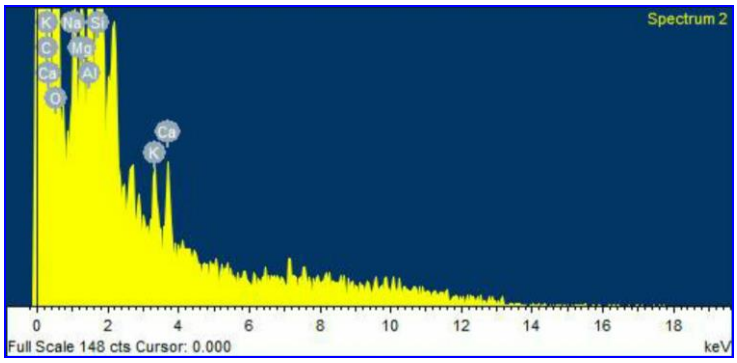

Figure (7) The distribution of elements by SEM technology for the laser beam sample and then the solidification by LED

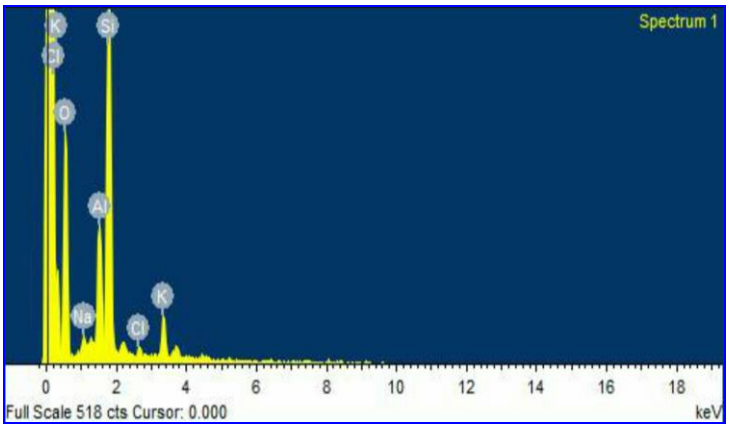

Figure (8) The distribution of elements by SEM technology for the solid sample by LED and then irradiated by the light

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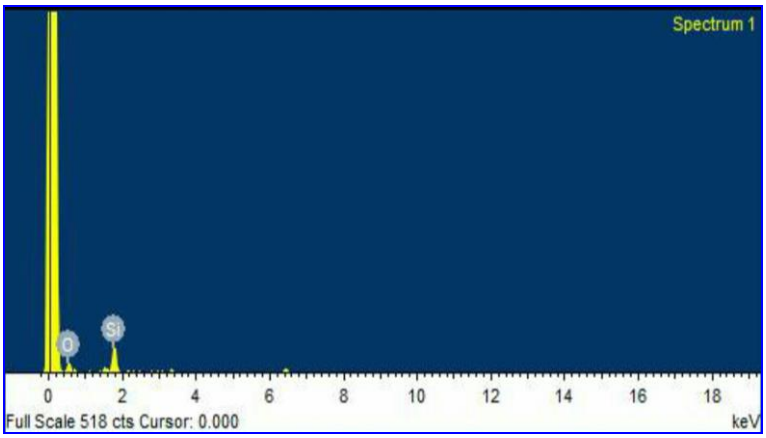

Figure (9) Distribution of elements using SEM for the laser beam sample and then the solidification by LED at the same time

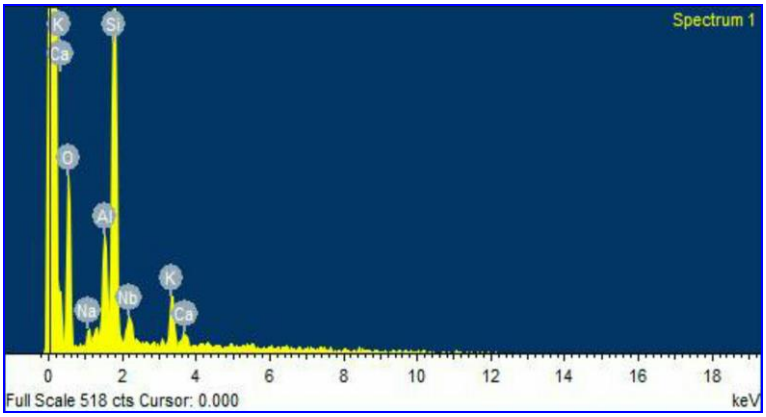

Figure (10) Distribution of elements by SEM for the original non-irradiated sample (control)

Table (1) shows the expected weight and the observed weight of the laser-beam sample and the solidification by LED

Element	Weight%	Atomic%
O K	63.51	75.54
Na K	1.80	1.49
Al K	7.54	5.32
Si K	23.03	15.61
Cl K	0.84	0.45
K K	3.29	1.60
Totals	100.00	

Table (2) shows the expected weight and the observed weight of the cruciferous sample by LED and laser irradiation

Element	Weight%	Atomic%
C K	47.09	55.22
O K	47.95	42.22
Na K	0.46	0.28
Mg K	0.52	0.30
Al K	1.19	0.62
Si K	2.50	1.25
K K	0.12	0.04
Ca K	0.16	0.06
Totals	100.00	

Table (3) shows the expected weight and the observed weight of the laser-beam sample and the solidification of the LED at the same time

Element	Weight%	Atomic%
O K	60.47	72.51
Na K	3.12	2.61
Mg K	0.22	0.18
Si K	36.18	24.71
Totals	100.00	

Table (4) shows the expected weight and weight of the original non-irradiated sample (control)

Element	Weight%	Atomic%
O K	57.12	72.32
Na K	1.80	1.58
Al K	6.36	4.78
Si K	23.98	17.30
K K	4.68	2.43
Ca K	0.97	0.49
Nb L	5.08	1.11
Totals	100.00	

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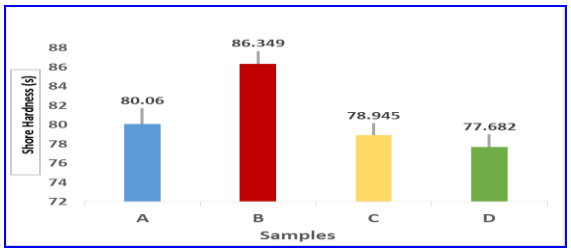

Figure (11): Evaluation of Shore Hardness between group D with groups A, B, C by T-test

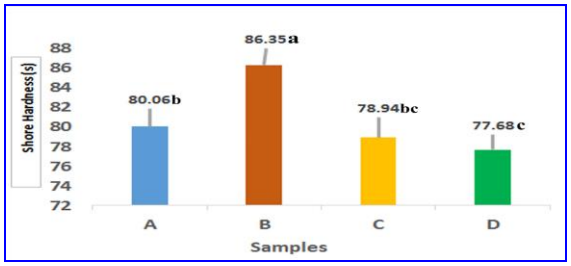

Figure (12) Evaluation of Shore Hardness between group D with groups A, B, C by Duncan test

Table (5): Evaluation of Shore Hardness between group D with totals A, B, C by T-test

Parameters	Groups	N	Mean±SD	P-Value
Shore Hardness (S)	D	10	77.68±2.42	N.S
	A	10	80.06±4.12	
	D	10	77.682±2.42	0.01
	B	10	86.359±1.44	
	D	10	77.68±2.42	N.S
	C	10	78.945±1.73	

Table (6) Evaluation of Shore Hardness between group D with groups A, B, C by Duncan test

parameters	Groups	N	Mean±SD
Shore Hardness (S)	A	10	80.06^{b}±4.12
	B	10	86.35^{a}±1.435
	C	10	78.94^{bc}±1.728
	D	10	77.68^{c}±2.418

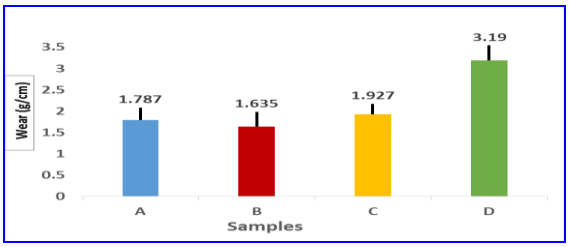

Figure (13): Evaluation of wear between group D with groups A, B, C by T-test

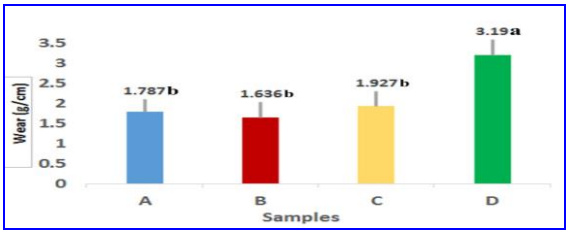

Figure (14): Evaluation of wear between group D with groups A, B, C by Duncan test

Table (7) Evaluation of wear between group D and groups A, B, C by T-test

parameters	Groups	N	Mean±SD	P-Value
Wear (g/cm)	D	10	3.19±2.22	0.05
	A	10	1.787±0.563	
	D	10	3.19±2.22	0.05
	B	10	1.636±0.297	
	D	10	3.19±2.22	N.S
	C	10	1.927±0.509	

Table (8) Evaluation of wear between group D and groups A, B, C by Duncan test

parameters	Groups	N	Mean±SD
Wear (g/cm)	A	10	1.787^{b}±0.563
	B	10	1.635^{b} ±0.297
	C	10	1.927^{b}±0.509
	D	10	3.190^{a}±2.222

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دراسة تأثير الليزر الدايود على خصائص مادة الحشوة الضوئية للأسنان

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الملخص

في هذه الدراسة تم استخدام حشوة أمامية من نوع G-aenial والمستخدمة في ترميم الأسنان ، بعدها أجريت عليها دراسة وقسمت إلى أربع مجاميع العينة الأولى والتي هي مجموعة A التي تم تشعيعها بليزر ثم تصليبها بالعلاج الضوئي Light Curing والعينة الثانية B والتي تم تصليبها بالعلاج الضوئي Light Curing ثم تشعيعها بالليزر والعينة الثالثة C التي تم تشعيعها بالعلاج الضوئي Light Curing والليزر على العينة في نفس الوقت والعينة الرابعة D العينات الأصلية الغير معرضة للتشعيع (الكونترول) واستنادا على مواصفات الحشوة تم تحضير العينة بشكل اسطوانية وبأبعاد (10×6mm) وتم استخدامها في عدد من القياسات التركيبية مثل تحليل حيود الأشعة السينية والمجهر الألكتروني الماسح وبعض الخصائص الميكانيكية المهمة مثل الصلادة والبلى. وأظهرت نتائج حيود الأشعة السينية أنَّ المكونات للمجاميع A,B,C,D أعطت قمماً مستطاره منبعثة وبحالة بلورية نحيفة (Crystalline) واضحة لجميع أشكال حيود الأشعة السينية . بينت النتائج أن فحص XRD لمجموعة B حدث فيه ارتفاع كبير في الشدة للمواد في حشوة G-aenial وذلك نتيجة لتأثير الليزر بشكل واضح بعد إجراء المعالجة بالضوء ثم التشعيع بالليزر. وأظهرت نتائج الفحص المجهري SEM للمجموعة B في حالة المعالجة بالضوء ثم التصليب بالليزر تجانساً واضحاً وأفضل توزيع ذري مقارنة مع المجاميع الأخرى المدروسة.