

Sudan University of Science & Technology  
College of Post Graduate Studies

Hardness Improvement of Teeth Filling  
Material (Amalgam) by Using He-Ne Laser  
632.8nm and Diode Laser 675nm

By

HALA JAFAR ALAMIN AHMED

Supervisor

Dr. BABIKER OSMAN ELBASHIR

May 2006



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

اللَّهُ لَا إِلَهَ إِلَّا هُوَ الْحَيُّ الْقَيُّومُ لَا تَأْخُذُهُ سِنَّةٌ وَلَا نَوْمٌ لِمَا فِي السَّمَاوَاتِ  
وَمَا فِي الْأَرْضِ مَنْ ذَا الَّذِي يَشْفَعُ عِنْدَهُ إِلَّا بِإِذْنِهِ يَعْلَمُ مَا بَيْنَ أَيْدِيهِمْ  
وَمَا خَلْفَهُمْ وَلَا يُحِيطُونَ بِشَيْءٍ مِنْ عِلْمِهِ إِلَّا بِمَا شَاءَ وَسِعَ  
كُرْسِيُّهُ السَّمَاوَاتِ وَالْأَرْضَ وَلَا يَئُودُهُ حِفْظُهُمَا وَهُوَ الْعَلِيُّ الْعَظِيمُ

## ***Dedication***

*I would like to express my sincere thanks and appreciation for my supervisors, and the warm welcome which you provided to me, together with, my family*

# I

## ***Acknowledgment***

*Gratitude and sincerely appreciations are only one way of many was saying thank you to my supervisor and lecturers.*

*Dr. Nafie Abed Al Latif is to be given credit for his efforts and encouragement in the preparation of this research.*

*Duely Dr. Babiker Osman to whom I am committed to his valued contribution, My God Bless you all. Through out the entire course that made this research become true. and the Khartoum Teeth Dental Medicine Centre Staff particularly Mr. Asmael Adam, and also, I*

*would like to extend my thanks to every individual whose support helped me to accomplished this research.*

## II

# Contents

Dedication	I
Acknowledgment	II
List of table	III
List of figures	IV
Abstract (E)	V
Abstract (A)	VI

### **Chapter One**

#### **Introduction and Basic Concept**

1-1: Introduction	1
1-2: Fundamentals of laser	1
1:2:1: Electromagnetic radiation	1
1:2:2: Energy levels	3
1:3: Radiation and matter interaction	4
1:3:1: Absorption	4
1:3:2: Fluorescence	5
1:3:3: Stimulated emission	5
1:4: Basic elements of laser	6
1:4:1: Threshold condition	7

1:4:2: Rate equations	8
1:5: Properties of laser light	9
1:5:1: Monochromaticity	9
1:5:2: Collimation	9
1:5:3: Radiance	9
1:5:4: Coherence	9
1:6: Types of laser	10
1:6:1: Gas laser	11
1:6:2: Solid state laser	11

### III

1:6:3: Semiconductor laser	11
1:6:4: Dye laser	12
1:7: Laser classification	12
1:8: Dental composite biomaterial	13
1:8:1: Physical properties	14
1:8:2: Chemical properties	14
1:8:3: Composite restorative materials	15
1:8:4: Type of composites	16
1:8:5: Use of composite material	18
1:9: Dental materials	18
1:9:1: Metallic fillings	18
1:9:2: Alternatives of silver amalgams	19
1:9:3: Resin based composite filling	19
1:9:4: Disadvantage of resin-based composite filling	20
1:9:5: Enhancing the bond between resin and teeth	20
1:9:6: Bonded restorations	21
1:10: Mechanical Properties	22
1:11: Aims of work	25

## **Chapter Two**

### **Experimental parts**

2: 1: Introduction	26
2: 2: The used equipments and materials	26
2: 2:1: He-Ne laser	26
2: 2:2: Diode laser	26
2: 2:3: Brinell hardness test	27
2: 2:4: Amalgam material	28
2: 2:5: fixed artificial teeth	28
2: 2:6: Optical element	29
2: 3: Experimental set up	30
2:3:1: Phase one	30
2:3:2: Phase two	31

## IV

### **Chapter Three** **Results and Discussion**

3: 1: Introduction	33
3: 2: The spectroscopic study	33
3: 3: Results of phase one, irradiated with He-Ne laser	35
3: 4: Results of phase two, irradiated with omega laser	36
3: 5: Comparison between He-Ne and omega laser effects	37
3: 6: The hardness enhancement by the two lasers	38
3: 7: Discussion	39
3: 8: Conclusion	40
3: 9: Future work	41
Reference	42



## List of Tables

Table (1-1): Bifunctional primers are molecules with characteristic chemical groups at each end.	21
Table (3-1): The results of hardness test for samples after different period of time without irradiation and samples irradiated by He-Ne laser	35
Table (3-2): The results of hardness test for samples after different period of time without irradiation and samples irradiated by Omega laser	36
Table (3-3): Comparison of hardness between the samples irradiated by He-Ne laser and Omega laser	38
Table (3-4): The enhancement of hardness ( $\Delta H$ )	39

## VI List of Figures

- Figure (1-1): The electromagnetic spectrum, with wavelength and frequency indicated for different spectral region 3
- Figure (1-2): Schematic diagram of interaction of light with electronic energy levels in the process of absorption, fluorescence and stimulated emission. 5
- Figure (1-3): Schematic representation of hardness test. A, area of plastic deformation. P, normal load. 24
- Figure (2-1): Photograph of irradiation of Amalgam by He-Ne laser 632.8 nm, 1 mW. 31
- Figure (2-2): Photograph of irradiation by Amalgam by Omega laser 675 nm, 15 mW 32
- Figure (3-1): The absorption spectrum for Amalgam material 34
- Figure (3-2): The hardness of the sample after different period of time without irradiation and irradiated by He-Ne laser. 35

Figure (3-3): The hardness of the sample after different period of time without irradiation and irradiated by Diode laser.	37
Figure (3-4): The effect of the two lasers of the samples	38
Figure (3-5): Enhancement of hardness of the samples which irradiated by He-Ne laser and Omega laser	39

## VI Abstract

In this research we are studied the hardness of the amalgam teeth filling material by utilizing Brinell harness test apparatus. Several tests were carried out on different amalgam mixtures that were subjected to irradiation for the two minutes of both He-Ne lasers at wavelength 632.8 nm, 1 mW power, Omega laser with wavelength 675 nm, at a power 15 mW. The samples were left for different time intervals before hardness test were carried out.

Some other samples were prepared for test without irradiation, and then they were tested for hardness at different intervals also.

The samples were then compared to emphasize the effect of laser on the value of hardness.

The results appeared the increases of observation in the hardness of the samples irradiated by two lasers rather than the samples without irradiation.

The samples irradiated by Diode laser 15 mW appear the increasing of the hardness more than the samples irradiated by He-Ne laser 1 mW.

All of the samples irradiated by two lasers needed to 6 hours only to reach the value of hardness equally 30 hours for those samples without irradiated.

## VII

### الخلاصة

في هذا البحث تمت دراسة الزيادة في صلادة مواد حشوات الأسنان (الأمالا قم) بواسطة جهاز برينيل لإختبار الصلادة وذلك بتشجيعها لمدة دقيقتان بكل من ليزري الهليوم نيون ذو الطول الموجي 632,8 نانوميتر وبقدرة 1 ملي وات وليزر الدايدود (أوميقا) ذات طول موجي 675 نانوميتر وبقدرة 15 ملي وات وتركها لأزمان مختلفة (ساعتان ، 6 ساعات ، 10 ساعات ، 18 ساعة ، 24 ساعة و 30 ساعة) قبل إجراء اختبار الصلادة عليها

حضرت عينات أخرى (غير مشععة) وأجرى عليها اختبار الصلادة بعد تركها لنفس الأزمان ، ومن ثم قورنت النتائج بين العينات غير المشععة وتلك المشععة بليزري الهليوم نيون والدايدود ليزر كل على حدا وذلك لدراسة أثر الليزر على قوة تماسك تلك المادة

أظهرت النتائج زيادة ملحوظة في صلادة الحشوات المشععة عن تلك غير المشععة ، كما أن الحشوات التي شععت بليزر الدايدود 15 ملي وات أظهرت زيادة في الصلادة أكثر من تلك التي شععت بليزر الهليوم نيون 1 ملي وات كل العينات المشععة احتاجت لزمان 6 ساعات فقط لتصل إلى قيمة صلادة تعادل 30 ساعة عن تلك التي لم تشع

