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Sudan University of Science and Technology

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Laser Tonsillectomy

ازالة اللوز بالليزر

**Graduation Research Submitted in Partial Fulfillment for the requirement of
Higher Diploma Degree in laser Applications in Medicine
(Otorhinolaryngology)**

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Sincere greeting and thanks for my college at **Aldoha specialized ENT hospital** mainly the theater staff.

Lastly I would like to thanks my **parent, my wife and kids** for their kindness, patience and advice to help the others.

Abstract

Background:

Laser is an *acronym* of **light Amplification by Stimulated Emission of Radiation (LASER)**. Laser is an intense, collimated beam of pure, monochromatic, single wavelength light. There are many applications of laser in medicine, introduced recently in medicine in 2010 including the ENT, Head and Neck for **diagnostic** and **therapeutic** uses, in the different disciplines of medicine. Laser has been use in **ENT** clinically since late 1970. In the Sudan Laser is surgery with various operations mainly larynx, oral cavity, neck and tonsillectomy. This work is a trial to study the laser tonsillectomy and the outcome.

Research Objectives:

General Objective: **To study laser tonsillectomy and the outcome.**

Specific Objectives: **To sort out the possible complications in laser tonsillectomy. To detect the level of pain, following laser tonsillectomy. To find out ability of oral intake following laser tonsillectomy.**

Research methodology:

This is a prospective study was been done at **Aldoha ENT Specialized Hospital**. During the period from **December 2017 to March 2018**. There were 13 patients (cases) had been studied in this work, using laser for doing tonsillectomy. Inclusions criteria all patients presented to Aldoha ENT Specialized Hospital with chronic tonsillitis, with indication for surgery and accept or prefer laser tonsillectomy. Exclusions criteria; all patients refused laser tonsillectomy, or patients with concomitant complications. All patients refused to be included in this study.

The parameters of the laser instrument used in the study

Ceram-ptec, is a diode laser with hand pieces designed to be used with bare fibers, medical used for exact and precise guidance of medical probes.

The Results

The total number of the patients was 13 (cases), using a diode laser to perform tonsillectomy for them. The patient age group ranged from 5 to 60 years. Male were 4 patients (31%) and female were 9 patients (69%). Most of the patients were Sudanese 11 (84.6%). The most common presenting symptoms were sore throat, snoring. The most presented signs were hypertrophy of the tonsils bilaterally 11 patients (84.6%). Concern the operations all of the studied laser tonsillectomy done under general anaesthesia. Eleven patients (84.6%) bilateral tonsillectomy were done to them, two patients (15.4) bilateral tonsillectomy with uvulectomy (UPPP) were done and one (7.7%) patients a unilateral tonsillectomy only for biopsy purpose. No intra- operative nor post-operative complications apart of slight intra-operative bleeding in 12 patients (92.3%). In the post – operative follow up in the first week no pain in 7 patients (53.8%), slight pain in 5 patient(38.5%). There was no post- operative bleeding through the study period. There was no infection post- operative. All the studied patients (100%) had good healing, in the third and sixth weeks.

Conclusions: From this study we can conclude that laser tonsillectomy is not takes a lot of time, with a less bleeding, intra operative, post-operative, minimum post -operative complication, less post-operative pain, early oral intake and good healing.

Recommendation: From this study we recommend that encourage laser tonsillectomy. Do farther study with a larger number to insure and obtain acquired results.

الخلاصة

الخلفية :

الليزر هو اختصار لتضخيم الضوء بواسطة الانبعاث المستحث للإشعاع. الليزر هو شعاع مكثف ، متوازي ، أحادية اللون، واحادي الطول الموجي للضوء. هناك العديد من تطبيقات الليزر في الطب ، التشخيصية والعلاجية. يستخدم الليزر في مختلف التخصصات الطب. الليزر تم استخدامه في الأنف والأذن والحنجرة سريريا منذ أواخر عام 1970. في السودان تم استخدام الليزر مؤخرا في الطب في عام 2010 بما في ذلك الأنف والأذن والحنجرة، جراحة الرأس والرقبة مع مختلف العمليات خصيصة في الحنجرة، تجويف الفم و الرقبة و استئصال اللوزتين. هذا العمل هو التجربة لدراسة الليزر لاستئصال اللوزتين و نتيجته

أهداف البحث :

الهدف العام: دراسة استئصال اللوزتين بالليزر ونتيجته

الأهداف الخاصة: ايجاد المضاعفات المحتملة من استئصال اللوزتين بالليزر، الكشف عن مستوى الألم بعد استئصال اللوزتين بالليزر و معرفة المقدرة علي تناول عن طريق الفم بعد استئصال اللوزتين بالليزر.

منهجية البحث:

هذه دراسة استطلاعية متقدمة تم القيام به في مستشفى الدوحة التخصصي، خلال الفترة من كانون الأول / ديسمبر 2017 إلى آذار / مارس 2018. هناك 13 مريض (الحالات) ، باستخدام الليزر لاستئصال اللوزتين. للمرضى الذين لعمل استئصال اللوزتين. شوائب معايير جميع المرضى قدم حضروا لمستشفى الدوحة ووافقوا لاجراء العملية بواسطة الليزر وتم استثناء المرضى الذين رفضوا الليزر لاستئصال اللوزتين، أو المرضى الذين لهم مضاعفات، و المرضى الذين رفضوا إدراجهم في هذه الدراسة.

معدات الليزر الأداة المستخدمة في الدراسة

هو صمام ثنائي ليزر مع قطع اليد مصممة ليتم استخدامها مع العارية الألياف ptec - سيرام الطبية المستخدمة في الضبط و التوجيه الدقيق للضوء

النتائج:

إجمالي عدد المرضى كان 13 (الحالات) ، وذلك باستخدام ليزرثنائي الصمام لإجراء عملية استئصال اللوزتين بالنسبة لهم. الاعداد تراوحت بين 5 إلى 60 عاما. الذكور كان عددهم 4(31%). معظم المرضى السودانيين 11 (84.6%). الأكثر شيوعا كانت أعراض التهاب

الحلق و الشخير. أكثر العلامات كانت تضخم اللوزتين بشكل ثنائي 11 المرضى (84.6%).
الأسبوع الأول من شكي 7 من المرضى من ألم (53.8%), ألم طفيف في 5
المريض (38.5%). لم يكن هناك بعد العملية نزيف خلال فترة الدراسة. لم يكن هنالك التهاب بعد
الجراحة. كل المرضى (100%) قد الشفاء جيدة في الثالث والسادس

الاستنتاجات:

من خلال هذه الدراسة يمكننا أن نستنتج أن استخدام الليزر لاستئصال اللوزتين لا يأخذ الكثير من
الوقت ، مع أقل نزيف داخل العملية و بعد العملية الجراحية, الحد الأدنى بعد الجراحة
للمضاعفات, أقل ألم ما بعد الجراحة و تناول عن طريق الفم مبكرا مع الاستشفاء جيدة.

التوصية:

من هذه الدراسة نوصي بأن نشجع استخدام الليزر لاستئصال اللوزتين. عمل دراسة بها عدد
أكبر من المرضى للحصول على النتائج المكتسبة.

Keywords and acronyms

(λ)	Wave length (lambda)
CO ₂	Carbon dioxide
CW	Continuous wave
ENT	Ear, Nose and Throat
GaAs	Gallium arsenide
Hb	Hemoglobin
He	Helium
I.R.	Infra red
LIDER	Light Detection And Ranging
Lt	Left
Nd: YAG laser	Neodymium Yttrium: aluminum garnet lasers.
Ne	Neon
Rt	Right
URTI	Upper respiratory tract infection
USA	United State of America
UV	Ultra violet

Acronyms

LASER: Laser is an acronym or light Amplification by Stimulated Emission of Radiation.

MAZER : Mazer an acronym or light Amplification by Stimulated Emission of Radiation.

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Chapter 1

Introduction and Literature review

1.1 Overview

Laser is an *acronym* of **light Amplification by Stimulated Emission of Radiation**. Laser is an intense, collimated beam of pure, monochromatic, single wavelength light. This beam, if focused by a lens or concave mirror, produces a small spot of light with extremely high energy, which when directed at a tissues produces various effects that are harnessed for clinical use. (**Richa Sharma, Vibhu Sharma2010**).

There are many applications of laser in medicine, for **diagnostic** and **therapeutic** uses, in the different disciplines of medicine. Laser has been use in **ENT** clinically since late 1970s.1Many lasers are now available to **otorhinolaryngologist** and the choice of the appropriate wavelength may be confusing when the laser is used occasionally. (**K.K.R. Ramalingam, B. Sreeramurty and Ravi Ramalingam2014**). An essential condition for laser proper and successful use of laser in any specialty, is understanding of the characteristics and the limitation of the wavelength, interaction with tissues, mode of transmission, delivery system(optic ,contact and non-contact modes) and setting (power, repetition rate continuous versus pulse modes). This Knowledge permits the application of laser technology in the proper clinical setting and provides the best results. (**Stanley M. Shapshay Elie E. Rebeiz**).

There are many types of laser in the different applications in the ENT, mainly the Argon laser in the middle ear surgery as; stapedectomy and

tympanoplasty, polyps and tonsillectomy mainly in the patients with bleeding tendency as hemophilia. The carbon dioxide (CO₂) laser has a wide uses in the oral cavity as resection of a pre- cancerous lesions as leukoplakia, also used to free the tie tongue and removal of the nasal polyps, nasal adhesions (synechia). The Nd: YAG&CO₂ lasers are used in bronchial tree and vocal cord polyps, granulomas and tumours. (**Casro, et al1996, Reinissch, et al 1987**).

In the Sudan Laser is introduced recently in medicine including the ENT, Head and Neck surgery with various operations mainly larynx, oral cavity, neck and tonsillectomy. This work is a trial to study the laser tonsillectomy and the outcome.

1.2 Literature review

Laser is a light, which is produced by the amplification, stimulated, emission of radiation. In **1916, Albert Einstein** put the initial principle to improve the laser physics. A laser is a device that amplifies light and produces a highly directionally, high intensity beam, that most often has a very pure frequency or wavelength.(**William T. Silvast, 1996**).

The laser system is the outcome of the device which was called the **MAZER** developed by **Charles Townes**, in **1951 at Colombia University- USA**, in which he used the radio wave in state of the visible light. In 1960the first successful laser device was built by Theodore Maiman. (**Baxter, G D; Diamonto Poulos, C;O' Kane, S. et al 1995, William T. Silvast, 1996, Fuller, T.A.1987**).

Laser has many different applications in all fields; industry, military, science, speroscopy, aircraft and medicine for diagnostic and therapeutic

purposes. In the ENT specialty, the laser has been used since 1970 for different type of surgery as stapedotomy, tympanoplasty, in the ear. Oral lesions and tonsillectomy, laser also used in ENT endoscopy and microsurgery in the larynx and bronchial tree (**K.K.R. Ramalingam, B. Sreeramurthy and Ravi Ramalingam 2014, Q. Peng et al 2008, Dixon, J.A 1987**).

Tonsillitis and tonsillectomy

Tonsillitis is an inflammation process of the tonsils, it can occur at any age. The acute tonsillitis occurs more frequent in children and adolescence, and will be more severe, painful if occurs in adult, and with a long course of treatment. Acute tonsillitis can be due to viral infection, followed by bacterial affection. The main treatment of acute tonsillitis, is bed rest, analgesia, mouth gargle and antibiotic medication if the patient has fever with leukocytosis (in bacterial infection). **K.K.R. Ramalingam, B. Sreeramurthy and Ravi Ramalingam (2014), Q. Peng et al (2008)**

In chronic tonsillitis, with high frequencies more than 4-6 attacks per year the ultimate solution are surgical removal (tonsillectomy). There are different modalities of tonsillectomy; the classical removal, bipolar resection, cryosurgery and recently laser tonsillectomy. Laser tonsillectomy is a rapid safe painless, with minimum blood loss, can be performed under local or general anesthesia. There are many indications for tonsillectomy which are; recurrence of tonsillitis, recurrent attacks of peritonsillar abscesses (Quinsy), asymmetrical tonsils (suspicion of malignancy) etc... Laser tonsillectomy, is when the surgeon used a laser beam to dissect or remove tonsil completely, or a part of it. (**Paul W. Flint,**

Bruce H. Haughey, John K. Niparko - 2010) Many indications for laser tonsillectomy, as chronic tonsillitis, tonsillar stone (tonsillaroliths) enlargement a common cause of snoring in children and adult and sleeping apnea.

1.3 Problem statement

Tonsillectomy is a surgical procedure, done to remove diseased tonsil. The palatine tonsils are most commonly removed to improve the health condition of the patient. There are many tools to remove tonsils surgically. Here we try to study the laser tonsillectomy procedure and the outcome.

1.4 Research Objectives

1.4.1 General Objective:

- **To study laser tonsillectomy, and the outcome.**

1.3.2 Specific Objectives:

- To count the time taken the laser tonsillectomy.
- To find out the amount of blood loss in laser tonsillectomy.
- To sort out the possible complications in laser tonsillectomy.
- To detect the level of pain following laser tonsillectomy.
- To find out ability of oral intake following laser tonsillectomy.

1.5 Research methodology

This prospective study was been done at Aldoha ENT Specialized Hospital. During the period from December 2017 to March 2018. There were 13 patients (cases) had been studied in this work, using laser for doing tonsillectomy.

1.5.1 Inclusions criteria

- All patients presented to Aldoha ENT Specialized Hospital with chronic tonsillitis, with indication for surgery.
- All patients with chronic tonsillitis accept or prefer laser tonsillectomy.
- Patients from both sexes with chronic tonsillitis were included equally.
- Patients from all age groups with chronic tonsillitis were included.

1.5.2 Exclusions criteria

- All patients refused laser tonsillectomy.
- All patients with concomitant complications.
- All patients refused to be included in this study.

1.5.3 The parameters of the laser instrument used in the study

Ceram- ptec, is a diode laser with hand pieces designed to be used with bare fibers, medical used for exact and precise guidance of medical probes in patients. It is class 4; laser, with 5 control keys, with wavelength 980+/-30 nm \ CW 30 W (MAX)-invisible laser, and a guide beam 635+/- 10 nm \ CW 4 m W (MAX) visible laser .

1.6 Thesis layout:

This is a prospective study which was been done at Aldoha; ENT Specialized Hospital. During the period from the first of December 2017 to end of March 2018. There were 13 patients (cases) had been included in this study, using a diode laser to perform tonsillectomy for them. The patient age group ranged from 5 to 60 years, the mean age was (55—16) years (46.2%). Male were 4 patients (31%) and female were 9 patients (69%), with male to female ratio 1: 2.25. Most of the patients were Sudanese 11 (84.6%). Eight patients (61.6%) from Khartoum, 2 patients (15.4 %) from Wad Medani, tow from out of the Sudan (Juba, Umgamma).

The most common presenting symptoms were sore throat, snoring, fever in all of the patients (100%), apnea and change of voice 6 patients (46.2%), halitosis 4 patients (30.8%) and tow patients presented with mouth bleeding (15.7%).

The most presented signs were hypertrophy of the tonsils bilaterally 11 patients (84.6%) and right side in 2 patients (15.44%), and pale in two patients (15.4). Halitosis was in one patient (7.7%).

All of these operations were done under general anaesthesia. Eleven patients (84.6%) bilateral tonsillectomy were done to them, tow patients (15.4)

bilateral tonsillectomy with uvulectomy (UPPP) were done and one (7.7%) patients a unilateral tonsillectomy for biopsy purpose. No intra- operative or post-operative complications apart of slight intra-operative bleeding in 12 patients (92.3%) and only one patient with moderately bleeding.

In the post –operative follow up in the first week, slight pain in 5 patients (38.5%), one patient with moderate pain (7.7%). In the third week no pain in 12 patients (92.3%), only one patient had slight pain (7.7%). The pain is similar, in the six week post-operative. There was no post- operative bleeding through the study period. Post- operative eating, in the first week was good in 10 patients (76.9%), painful swallowing in three patients (23.1%). All the studied patients (100%) had good eating, in the third and sixth weeks. There was no infection post- operative. Healing was good all the studied patients (100%) had good healing, in the third and sixth weeks.

Chapter 2

Background

2.1 Laser

Laser is an acronym or light Amplification by Stimulated Emission of Radiation. Laser is an intense, collimated beam of pure, monochromatic, single wavelength light. This beam, if focused by a lens or concave mirror, produces a small spot of light with extremely high energy, which when directed at a tissues produces various effects that are harnessed for clinical use. (K.K.R. Ramalingam, B. Sreeramurthy and Ravi Ramalingam 2014, William T. Silvast, 1996).

2.1.1 The properties of laser

Laser light has unique properties, compared with other light sources. The properties are:

- **Monochromaticity**

The color of the light is determined by the length of its waves (λ). Laser light is single colored light (has one λ , or monochromatic). Each type of lasers has single wavelength.

- **Directionality**

All conventional light sources as a light bulb, emits light in all directions. The beam produced always diverges (spreads) more rapidly than the beam generated by a laser which is uni-direction.

- **Coherence**

All the photons in any laser light are coherent, i.e. they are in phase, while photons in other light sources have no relation between them, and i.e. they are out of phase. Depicts a parallel beam of light, the waves from an ordinary source traveling through space. None of these waves has any fixed relationship to any of the other waves within the beam. This light is said to be "incoherent".

- **High intensity:**

Laser light is the intense light ever been known. Each laser type has its own intensity which can be defined as the number of photons emitted per unit surface area per unit solid angle. Even lasers with low intensity, compared with other lasers, are intense more than the sun

light. This property is due to huge number of coherent photons emitted with very small angle (little divergence). (**William T. Silvast, 1996, Fuller, T.A.1987**).

2.1.2 Elements of laser

The laser system mainly has three basic components these are:

- a) Pumping source; is the energy source responsible for raising the atoms to the exciting state
- b) Laser medium or active media; this is the special material used as laser medium which when excited achieves population inversion. These specialized materials have properties to provide gain to the light beam making round trips in between the mirrors. The active medium may be a solid, liquid, gas or a semiconductor.
- c) Optical resonator; this is essentially an arrangement of the two mirrors enclosing the active medium and facing each other. This arrangement or system of two mirrors is said to be a cavity.

2.1.3 Principle of laser action

The principle of operation of all lasers is almost same, lasing action involve three basic steps;

- i) Photon absorption.
- ii) Spontaneous emission.
- iii) Stimulated emission.
- iv) Population inversion.

These components taken altogether are shown:

2.1.4 Laser types

Lasers may be classified according to the type of active medium, excitation mechanism, and region of emitted wavelength or mode of operation.

According to the active medium, lasers are classified to: solid, gas, liquid and semiconductor lasers.

According to the spectral region of the emitted laser, the classification is: UV, visible and I.R. lasers.

The common way of lasers classification is the way based on the physical state of the active medium.

Usually lasers are classified as:

- Gas lasers.
- Solid state lasers.
- Liquid (or dye) lasers.
- Semiconductor (or diode) lasers.

2.1.4.1 Gases lasers

A large and important family of lasers utilizes a gas or gas mixture as the active medium. Excitation usually is achieved by current flow through the gas as in Fig 2:1 and Fig 2:2. Gas lasers may be operated in either Continuous (CW) or pulse modes.

One popular type of gas laser contains a mixture of helium (He) and neon (Ne) gases contained at a low pressure within a sealed glass tube called the "plasma tube." The feedback mechanism consists of a pair of mirrors sealed to the ends of the plasma tube.

2.1.4.2 Solid state lasers

Another important family of lasers contains solid crystalline or glass material as an active medium. Ruby and neodymium are two common examples of solid lasers with widespread applications Fig 2:3. The chromium ions are the active elements in the ruby laser. Yttrium aluminum garnet (YAG) is the crystal host for Nd:YAG lasers. Glass is also used as a host for neodymium lasers.

2.1.4.3 Liquid (dye) lasers

The pump source is an argon laser, whose beam is focused to a small spot. The dye flows in a high velocity jet with the argon laser beam focused on the jet. The wavelength of the output is adjusted by the tuning element.

2.1.4.4 Semiconductor (diode) lasers

1. The active medium of a semiconductor (injection) laser is the junction between two types of semiconductor materials. A semiconductor is a material whose electrical conductivity is greater than that of an insulator, such as glass or plastic, but less than that of a good conductor. Gallium arsenide (GaAs) is an example of a material used in the manufacture of a semiconductor laser. (William T. Silvast, 1996, Fuller, T.A.1987).Laser can be delivered as free beam or transmitted by optical fire or articulated arms. Fig 2:4.(**Q. Peng et al2008**)



Fig: 2: 1 This picture shows the optical cavity of a gas laser with its totally reflecting mirrored end and partially reflecting mirrored end through which the laser beam is emitted. The energy source (not shown) is called the pump.



Fig: 2:2 Carbon dioxide laser.

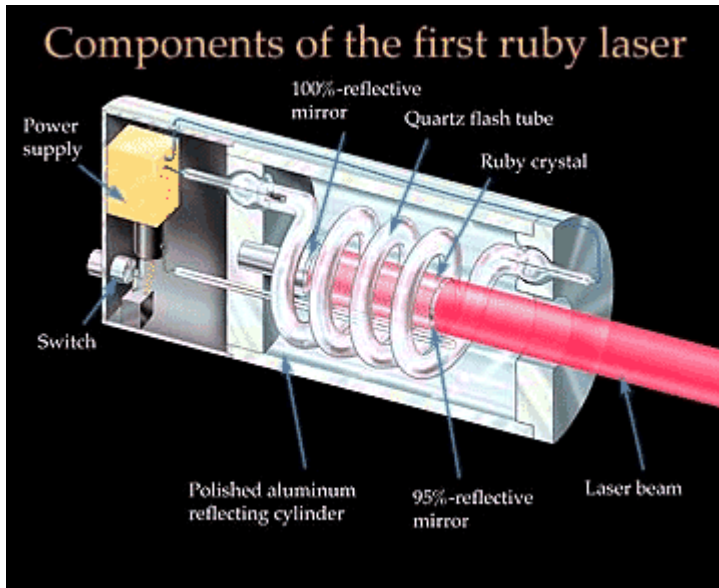


Fig:2:3 Ruby laser as example of solid laser



Fig: 2:4 shows the fibro-optic endoscope carrying the laser.

2.1.5 Laser Applications

There are a lot of applications for laser in the different fields; these can be summarized as follow:

2.1.5.1 Laser applications in medicine and surgery

- ❖ Laser diagnostic
- ❖ Lasers in ophthalmology
- ❖ Laser photocoagulation
- ❖ Treatment of Glaucoma
- ❖ Refractive Eye Surgery
- ❖ Laser in Dermatology

2.1.5.2 Laser in Material Processing

- Laser cutting
- Laser drilling
- Laser welding

2.1.5.3 Laser in optical communication

- Optical fiber communication
- Free space communication

2.1.5.4 Laser metrology and Lidar

- LASER Doppler anemometry
- Laser alignment
- Laser velocimeter
- Pollutant detection system
- LIDER (Light Detection And Ranging)

2.1.5.5 laser in holography .

2.2 Medical Applications of Laser

Laser is widely used in medicine for diagnostic and therapeutic purposes

Laser applications in medicine and surgery;

2.2.1 Applications of Laser in ENT

In the ENT specialty, the laser has been used since 1970 for different type of surgery as stapidotomy, tympanoplasty, in the ear. Oral lesions and tonsillectomy, laser also used in ENT endoscopy and microsurgery in the larynx and bronchial tree (K.K.R. Ramalingam, B. Sreeramurthy and Ravi Ramalingam, Q. Peng et al 2008, Dixon, J.A 1987, Rein).

2.3 Tonsillitis

Tonsillitis is an inflammation process of the tonsils, it can occur at any age. The acute tonsillitis occurs more frequent in children and adolescence, and will be more severe, painful if occurs in adult, and with a long course of treatment. Acute tonsillitis can be due to viral infection, followed by bacterial affection as showed in Fig 2:5. The main treatment of acute tonsillitis, is bed rest, analgesia, mouth gargle and antibiotic medication if the patient has fever with leukocytosis (in bacterial infection).

In chronic tonsillitis, with high frequencies more than 4-6 attacks per year the ultimate solution is surgical removal (tonsillectomy). There are different modalities of tonsillectomy; the classical removal, bipolar resection, cryosurgery and recently laser tonsillectomy. Laser tonsillectomy, is a rapid safe painless, with minimum blood loss, can be performed under local or general

anesthi.(K.K.R. Ramalingam, B. Sreeramurty and Ravi Ramalingam2014,
Q. Peng et al 2008)

laser tonsillectomy has some advantages over dissection method. There is less operative time and intra-operative bleeding and less immediate post-operative pain. Disadvantage of laser tonsillectomy is that there is more pain in 5th to 6th post-operative period this may be due to thick slough formation.

MA Matin, M Alamgir Chowdhury(2012)

It has been said that laser excision of oral and oropharyngeal lesions result in less intraoperative blood loss, reduced postoperative pain and delayed wound healing, but few controlled studies have been done to substantiate these claims. A study was undertaken to examine the benefits of the diode laser in a group of 20 patients who underwent tonsillectomy. One side tonsil was removed with diode laser and the other side was excised with conventional dissection and snare technique. The results were as follows : 1) In comparison with standard dissection and snare technique, laser tonsillectomy had less postoperative throat pain, less intraoperative blood loss, but longer operation time. 2) Postoperative otalgia and incidence of postoperative bleeding were statistically insignificant. From the above results, tonsillectomy with diode laser may be useful for patients with clotting abnormalities or sensitive patients in pain or children need less bleeding.(**Yeon Kuk Choi, and et al 1996**)

To compare contact diode laser (CDL) tonsillectomy to monopolar cautery (MPC) with regard to pain and other morbidity during recovery. The Study

design and setting, Single-blind, randomized trial in a tertiary-care pediatric hospital. Tonsillectomy was performed by CDL in 30 children and by MPC in 28.

There was significantly less pain in the CDL group than in the MPC group. The CDL group also required much less medication, and was much less likely to experience multiple awakenings ($P < 0.001$ for all comparisons). Postoperative pain is a major concern for surgeons, patients, and their parents. The long recovery period also has costs in school days missed for the child and work missed for the parents. CDL tonsillectomy may greatly mitigate these burdens.

2.4 Laser Tissue interactions

2.4.1 The basic phenomena always accompanying the light- tissue interaction.

When a photon strikes the tissues one or other or all occur;

- Absorption
- Reflection
- Scattering
- Transmission

This depends on the optical properties of the tissues to the specific laser as showed in Fig 2:6 .The type of the Laser Tissue interactions depend on;

- Wavelength
- Interaction duration

2.4.2 Mechanism of laser interaction with the human tissues

Classification;

Types of laser interactions that developed with the tissue:

- a) Low; photochemical
- b) Medium; photothermal
- c) Greater; photofragmentation

2.3.3 Selective absorption of laser by Human tissue

Selective absorption occurs when a given color of light is strongly absorbed by type of tissue, while transmitted by another as showed in Fig 2:7 .The laser pure color is responsible for selective absorption.

The main absorption components of the tissues are:

- i) Oxyhemoglobin (in blood)

The blood s oxygen carries protein absorption of UV and blue and green light.

- ii) Melanin (a pigment in the skin, hair, moles, etc.)

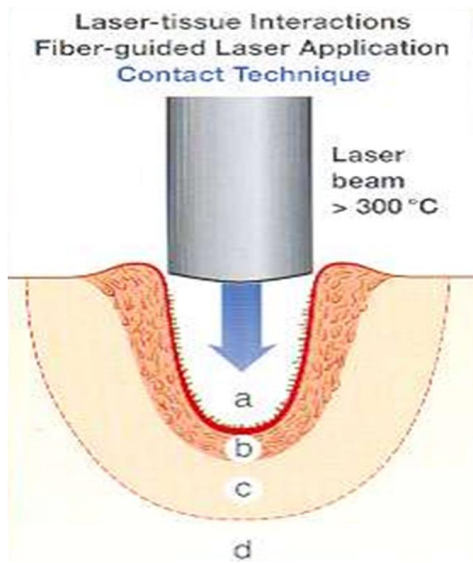
Absorption in visible and near near IR light (400nm---1000nm)

- iii) Water (in tissue) transpirrent to visible light but strong absorption of U V light below 300nm and over 1300nm)

Laser tissue interaction depends on the absorption of laser by the tissue.as showed in Fig2:7



Fig:2:5 Shows the shape of the enlarged tonsils



a= vaporization zone b= coagulation zone c= cavitation zone
D=tissue repair

Fig: 2:6 Show the Tissue interaction to laser.

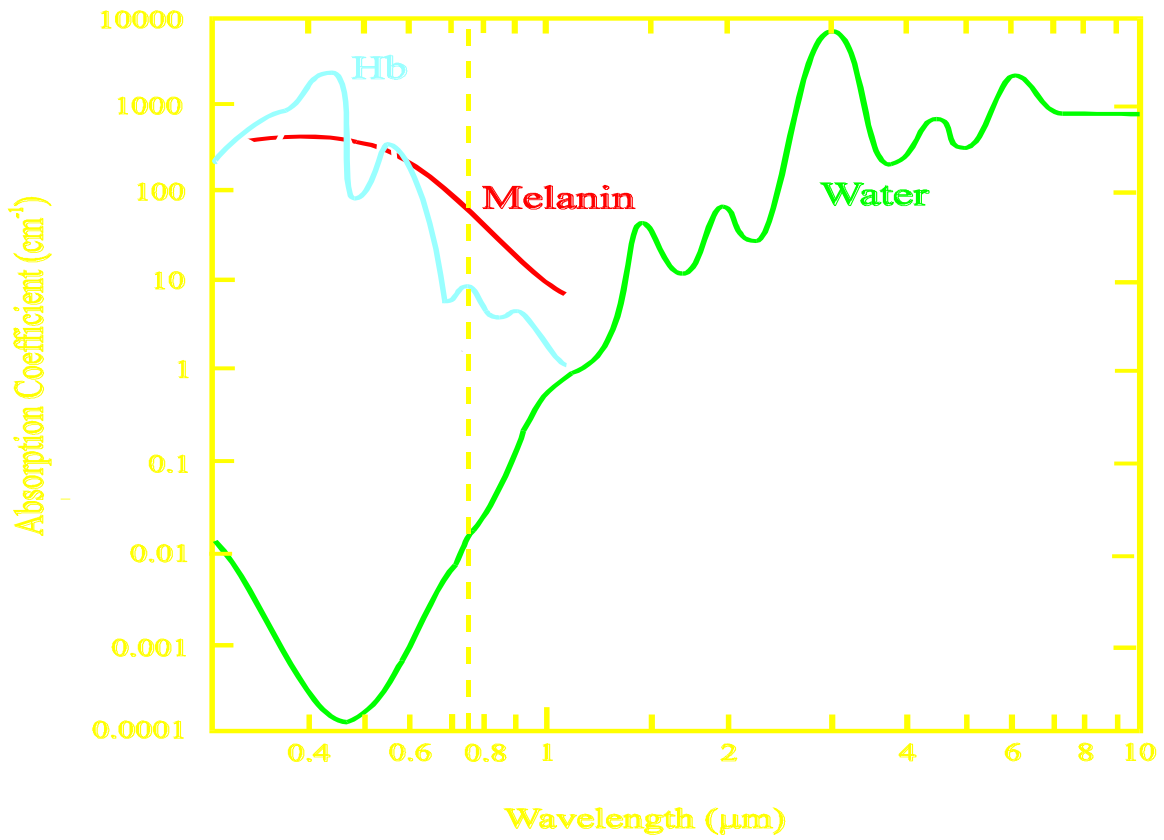


Fig: 2: 7 Show the Tissue absorption according to laser wave lengths.

Chapter 3

Method and techniques

3.1 Introduction

3.2 Materials and tools

3.3 Experimental procedure

3.4 Characterization techniques

3.1 Introduction:

There are many applications of laser in medicine, for **diagnostic** and **therapeutic** uses. In the Sudan Laser is introduced recently in medicine in 2010 including the ENT, Head and Neck surgery with various operations mainly larynx, oral cavity, neck and tonsillectomy. This work is a trial to study the laser tonsillectomy and the outcome.

3.2 Materials and tools:

This study was been done at **Aldoha ENT Specialized Hospital**. During the period from **December 2017 to March 2018**. There were 13 patients (cases) had been studied in this work, using laser for doing tonsillectomy. The laser was diode type in well-equipped and prepared room, optical fiber to transmit the laser glasses as showed in Fig 3:1, Fig 3:2 and Fig 3:3.

. The operative staffs wearing laser protective glasses as showed in Fig 3:4.

The parameters of the laser instrument used in the study

Ceram- ptec, is a diode laser with hand pieces designed to be used with bare fibers, medical used for exact and precise guidance of medical probes.

3.3 Experimental procedure:

This is a prospective study which was been done at Aldoha; ENT Specialized Hospital. During the period from the first of December 2017 to assess the effects of laser in tonsillectomy operative time saving, decrease the operative and postoperative bleeding. Improve the postoperative oral intake, together with diminish the postoperative pain and promote the healing process. This obtained by filling the well-designed questioner. Close and regular follow up. Then analyze the data using SPSS.

3.4 Characterization techniques;

The characteristic techniques of this study is that laser tonsillectomy is not takes a lot of time, with a less bleeding, intra operative, post-operative, minimum post -operative complication, less post-operative pain, early oral intake and good healing, as showed in Fig 3:5 and Fig 3:6.



Fig:3:1 The diode laser used in the research



Fig:3:2 The operation room for laser surgery.

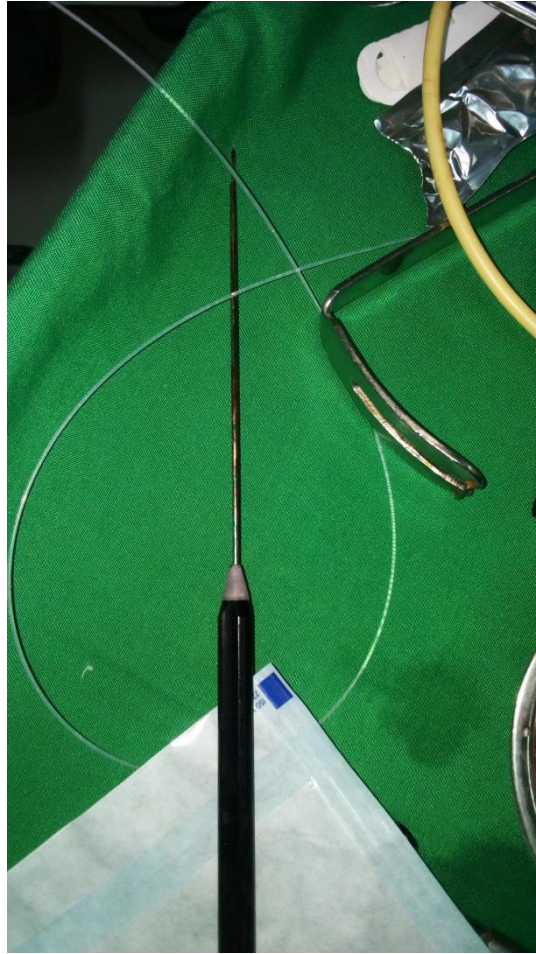


Fig: 3:3 The optic fiber with the hand piece used for laser tonsillectomy



Fig: 3:4 The protective eye glasses

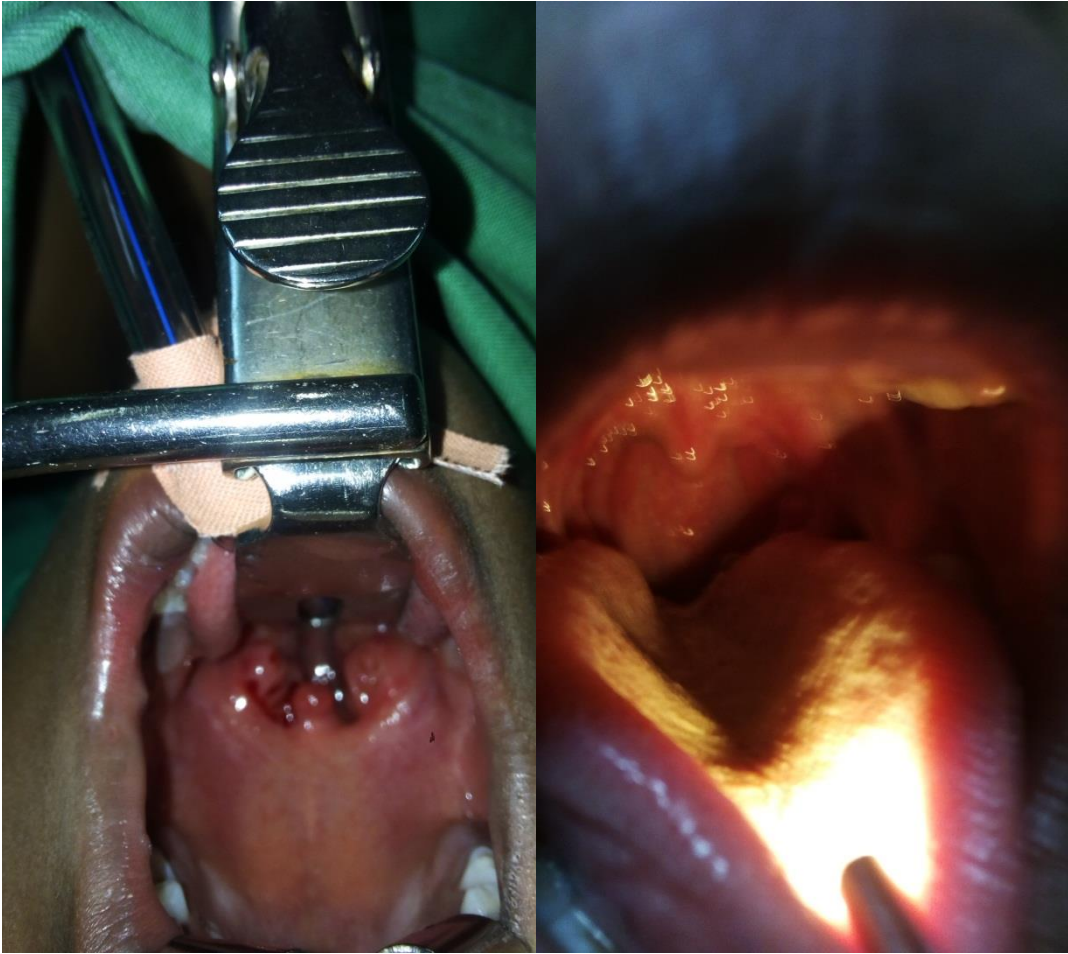


Fig: 3:5 pre- operative tonsils view Fig: 3:6 post- operative tonsils view

Chapter 4

Results and Discussion

Laser tonsillectomy

4.2 Results and Discussion

This is a prospective study which was been done at Aldoha ENT Specialized Hospital. During the period from the first of December 2017 to end of March 2018. There were 13 patients (cases) had been included in this study, using a diode laser to perform tonsillectomy for them. The patient age group ranged from 5 to 60 years, the mean age was as showed in Fig 4:1.

Male were 4 (31%) and female were 9(69), with male to female ratio 1: 2.25, as showed in Fig 4:2. Most of them were students (53,8%) as showed in Fig 4:3.

Most of the patients were Sudanese 11 (84.6), two patients were foreigner (15.4%), as showed in Fig 4:4.

. Eight patients (61.6%) from Khartoum, 2 patients (15.4 %) from Wad Medani, tow from out Sudan (Juba, Umgammsana) and one patient(7.7%) from Babanosa, as showed in Fig 4:5.

The most common presenting symptoms were sore throat, snoring, fever in all of the patients (100%), followed by mouth breathing 8 patients (61.5%),

URTI & difficulty in swallowing 7 patients (53.8%), apnea and change of voice 6 patients(46.2%), halitosis 4 patients(30.8%) and tow patients presented with mouth bleeding (15.7%) as showed in Tab 4:1 and Fig 4:6 and Fig 4:7.

The most presented signs was hypertrophy of the tonsils bilaterally 11 patients(84.6%) and right side in 2 patients(15.44%).The texture was soft in 11 patients(84.6%) and irregular and asymmetric only in two patients(15.4) mainly in the right side as showed in Fig 4:8,9,10 and 11 . The surface was smooth in 11 patients (84.6%) and rough and irregular in two patients (15.4) as showed in Fig 4:12. The color of the tonsils was red and congested in11 patients (84.6%) and pale in two patients (15.4) as showed in Fig 4:13.The smell of the mouth was unchanged-normal- in 12 patients (92.3%) only changed – halitosis- in one patient (7.7%) as showed in Fig 4:14.

About the knowledge of the patients and their relatives about laser surgery; most of them (61.5%) they did not know and only (38.5%) they know laser and laser surgery as showed in Fig 4: 15. Inspire of that 92.3% they preferred to do laser tonsillectomy as showed in Tab 4: 2and Fig 4:16.

Concern the operations all of the studied laser tonsillectomy done under general anaesthesia as showed in Fig 4:18. Eleven patients (84.6%) bilateral tonsillectomy were done to them, tow patients (15.4) bilateral tonsillectomy with uvulectomy (UPPP) were done and one (7.7%) patients a unilateral tonsillectomy only as showed in Tab 4:3 and Fig 4:19. No intra-operative or post-operative complications apart of slight intra-operative

bleeding in 12 patients (92.3%) and only one patient with moderately bleeding no sever one as showed in Fig 4:20. The bleeding was mostly from the left tonsil (69.2%) as showed in Fig 4: 21and Fig 4: 22.

In the post –operative follow up in the first week no pain in 7 patients (53.8%), slight pain in 5 patient(38.5%), one patient with moderate pain(7.7%).In the third week no pain in 12 patients (92.3%),only one patient hah slight pain(7.7%). The pain is similar, in the six week post-operative as showed in Tab4:4 and Fig 4:24. There was no post- operative bleeding through the study period as showed in Tab4:5 and Fig 4:25. Post-operative eating, in the first week was good in 10 patients (76.9%), painful swallowing in three patients (23.1). All the studied patients (100%) had good eating, in the third and sixth weeks as showed inTab4:6 and Fig 4:26. Concerned the infection post-operative, There was no infection post-operative as showed in Tab4: 7 and Fig 4:27. Healing was good in the first week; in 10 patients (76.9%), delayed healing in patients (23.1). All the studied patients (100%) had good healing, in the third and sixth weeks as showed inTab4 :4 and Fig 4:24.

This results revels that laser in tonsillectomy has a good intra operative outcome, saving time, with a lesser blood loss. A nice post-operative condition; decrease pain, early oral intake, no infection and good and rapid healing. Which are similar to the international results.

Results

Age

Figure

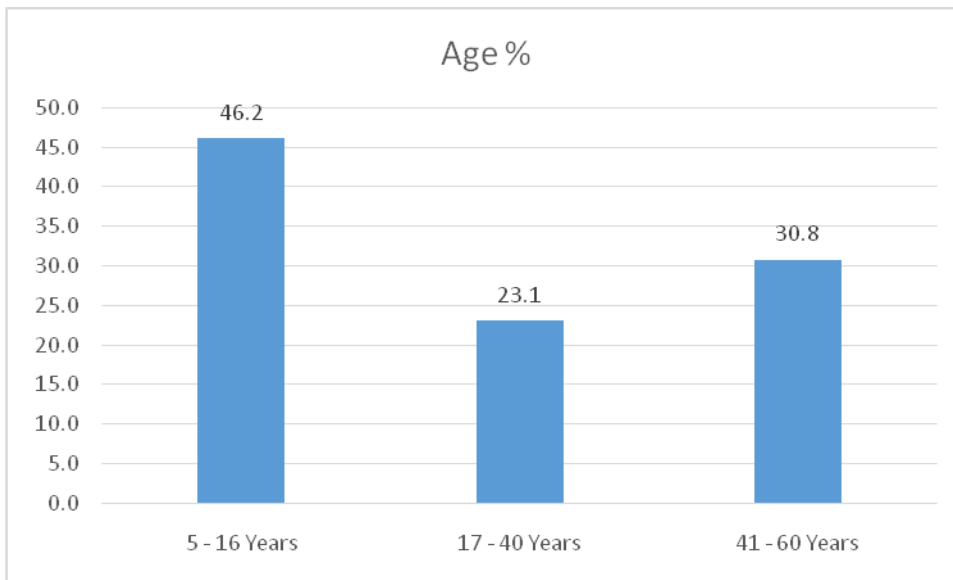


Fig: 4:1 show the age group in patients prone to laser tonsillectomy.

Sex

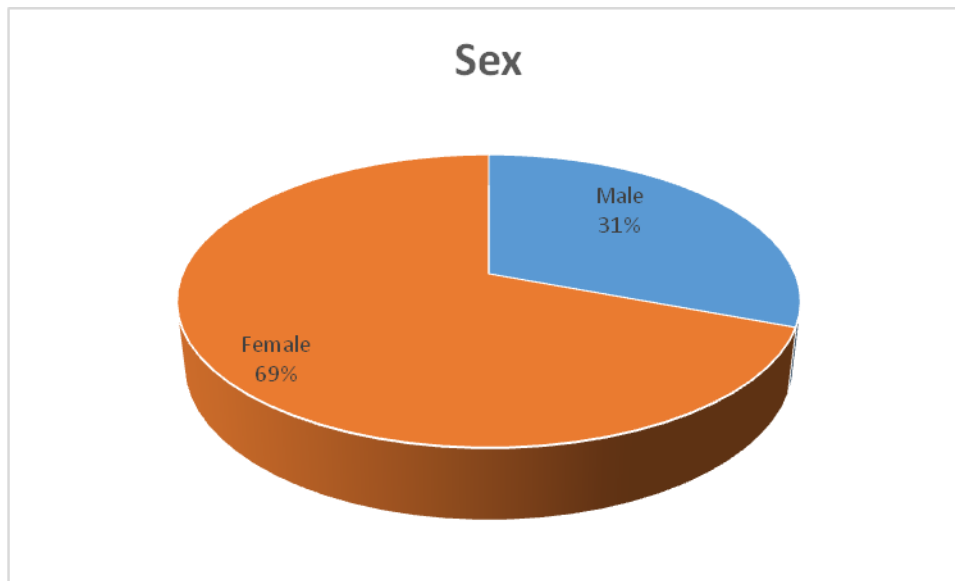


Fig: 4:2 show the sex distribution in the patients prone to laser tonsillectomy.

Occupation

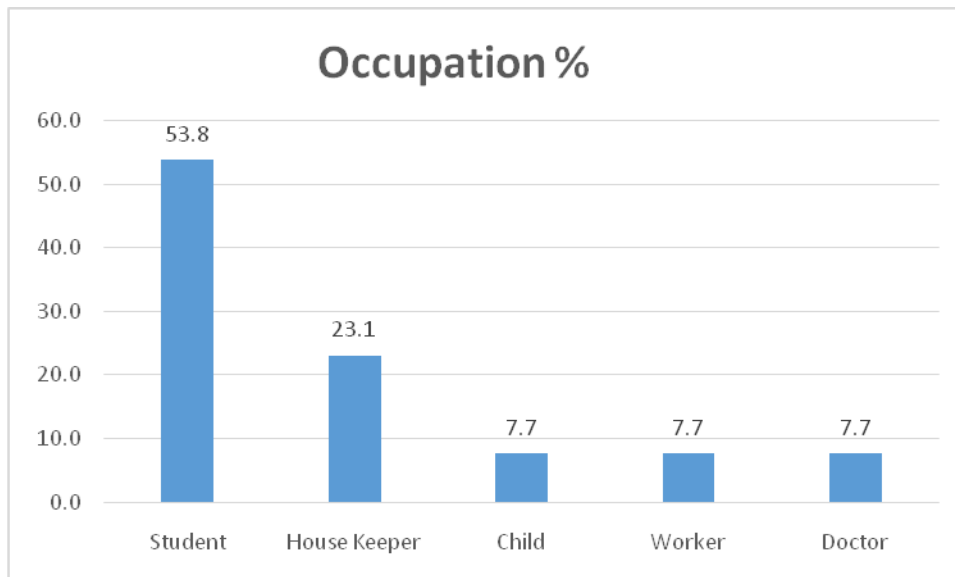


Fig: 4:3 show the occupations of the study group.

Nationality

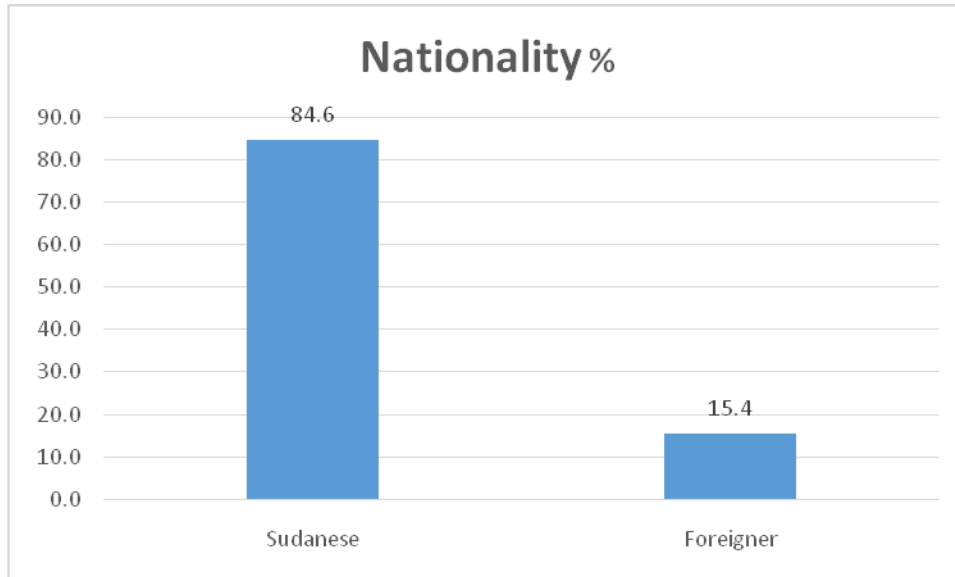


Fig: 4:4 show the nationality of the patients prone to laser tonsillectomy.

Residence:

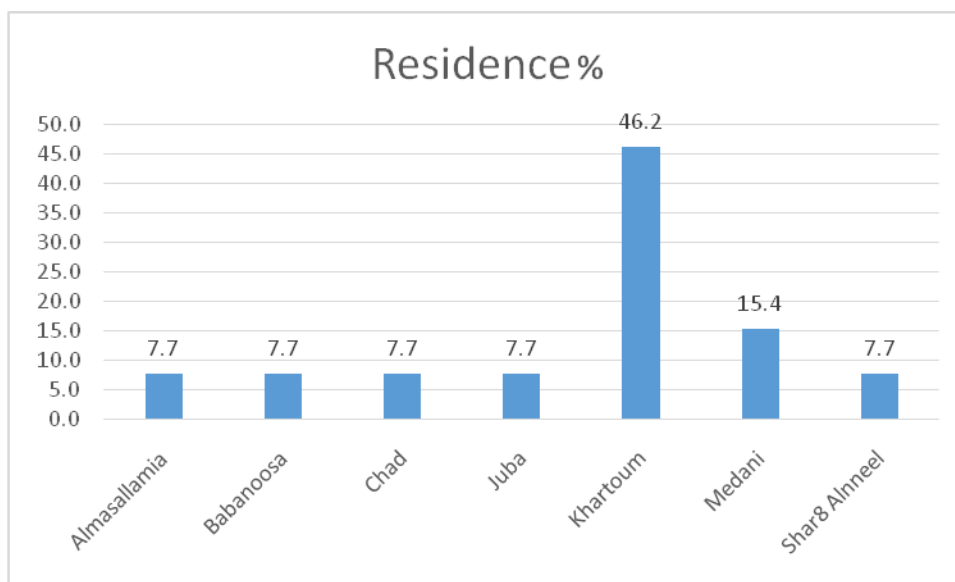


Fig: 4:5 show the residence of the study group of the laser tonsillectomy.

Complains:

a) Symptoms

Tab : 4:1 show the symptoms of the study patients prone to laser tonsillectomy.

		Percent of Cases	
		No	
Complains_Symptoms ^a	Sore throat	13	100.0%
	Fever	13	100.0%
	URTI	7	53.8%
	Snoring	13	100.0%
	Apnea	6	46.2%
	Difficult of swallowing	7	53.8%
	Mouth breathing	8	61.5%
	Mouth bleeding	2	15.4%
	Change of voice	6	46.2%
	Halitosis	4	30.8%
	Total	79	607.7%

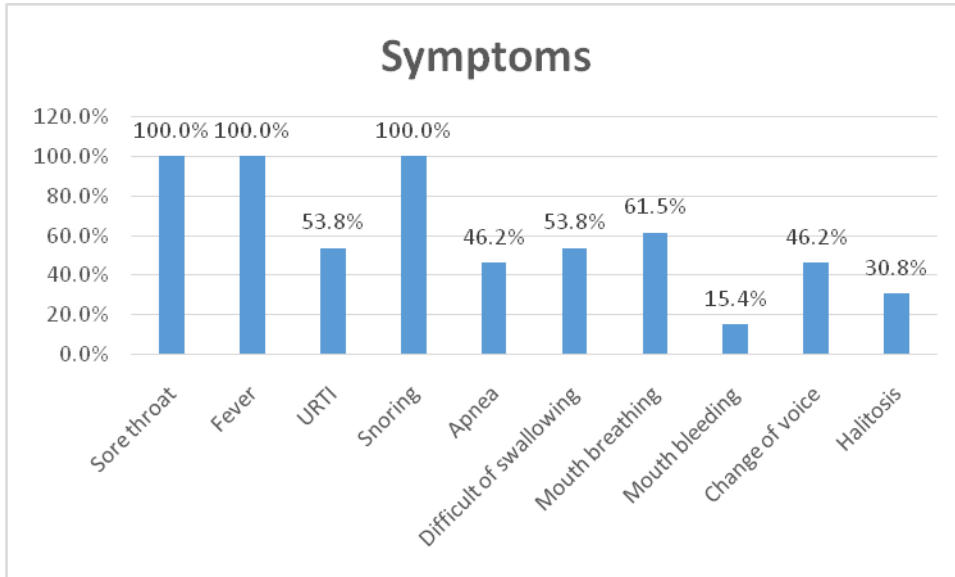


Fig: 4:6 show the symptoms of the patients prone to laser tonsillectomy.

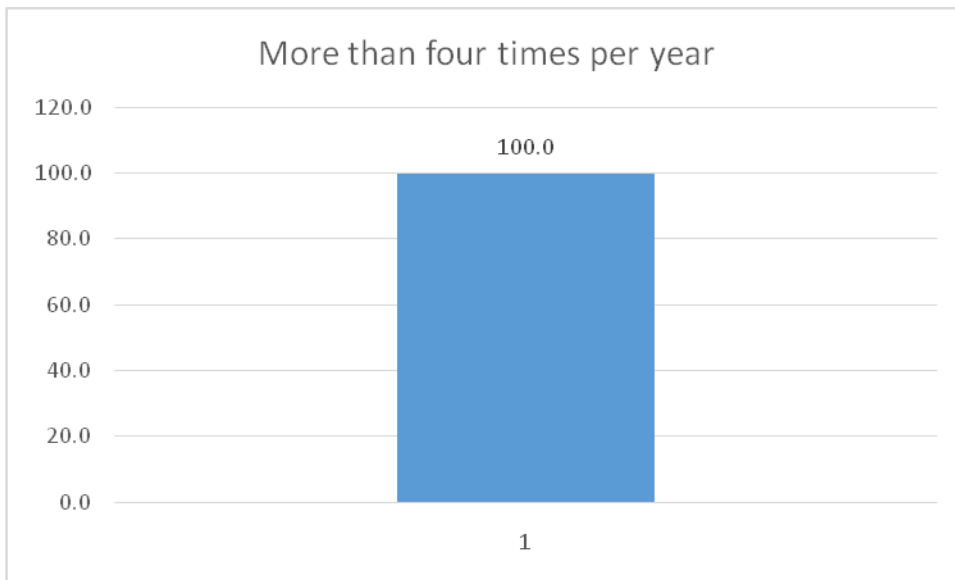


Fig: 4:7 show the frequent of sore throat in patients prone to laser tonsillectomy.

b) Signs;

i) size of the tonsils

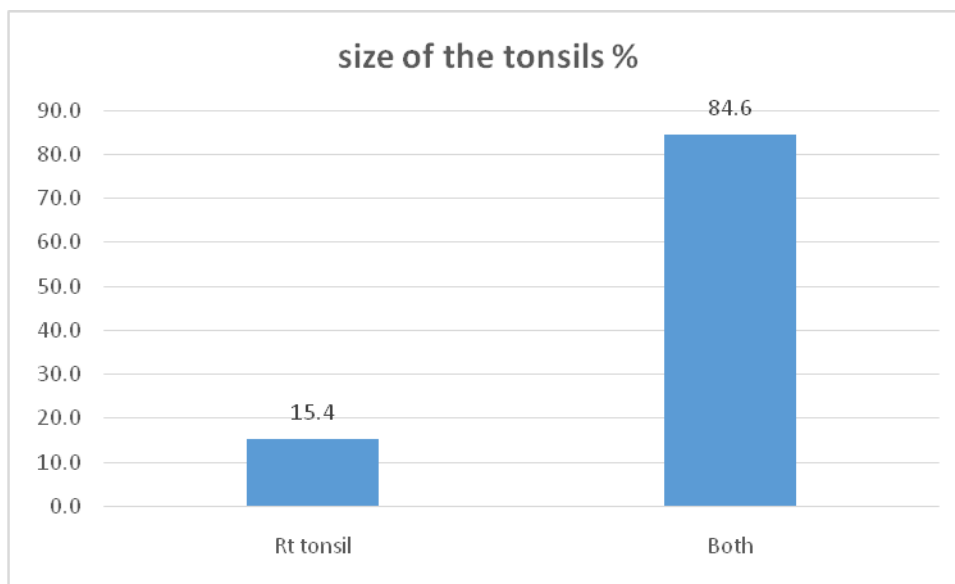


Fig: 4:8 show the enlargement of the tonsils in the studied patients.

ii) Texture of the tonsils

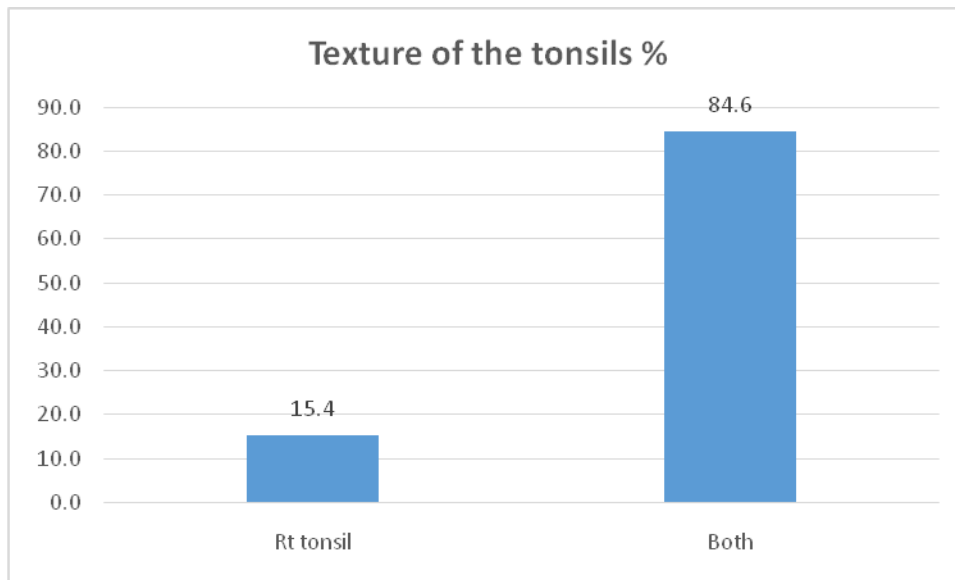


Fig: 4:9 show the texture of the tonsils in the studied group.

iii) A symmetry of the tonsil

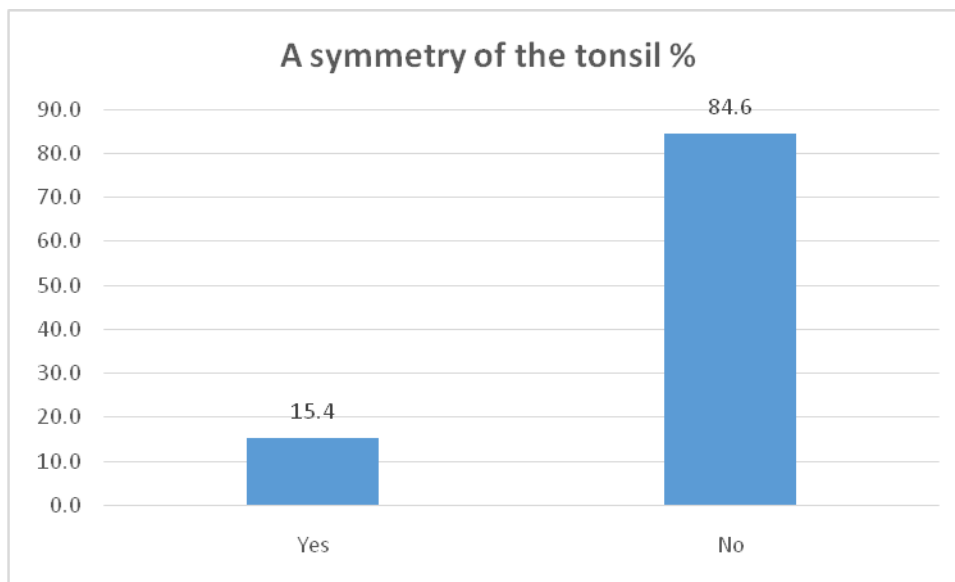


Fig: 4:10 show the incidence of asymmetry of the tonsils.

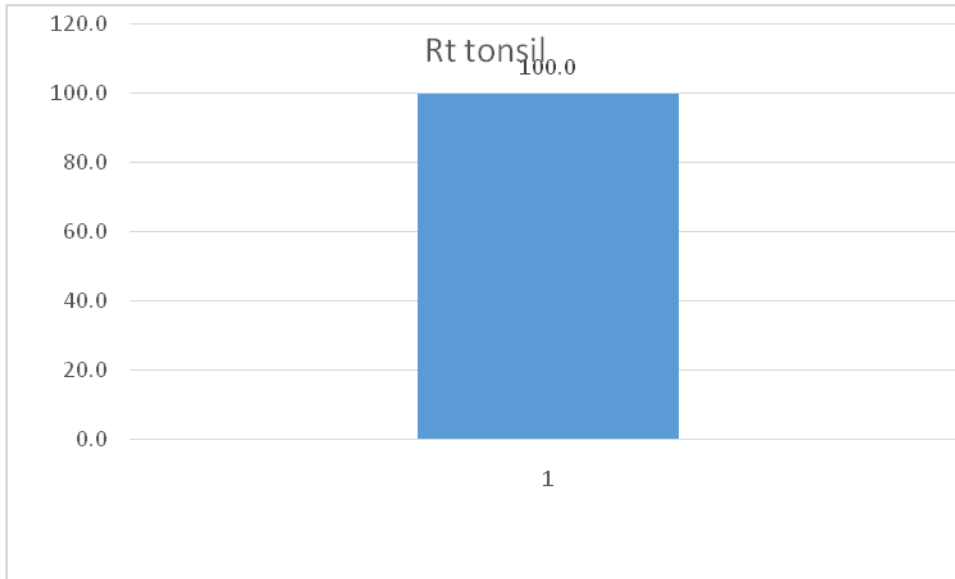


Fig: 4:11 show the asymmetry in the patients prone to laser tonsillectomy.

iv) Surface of the tonsils

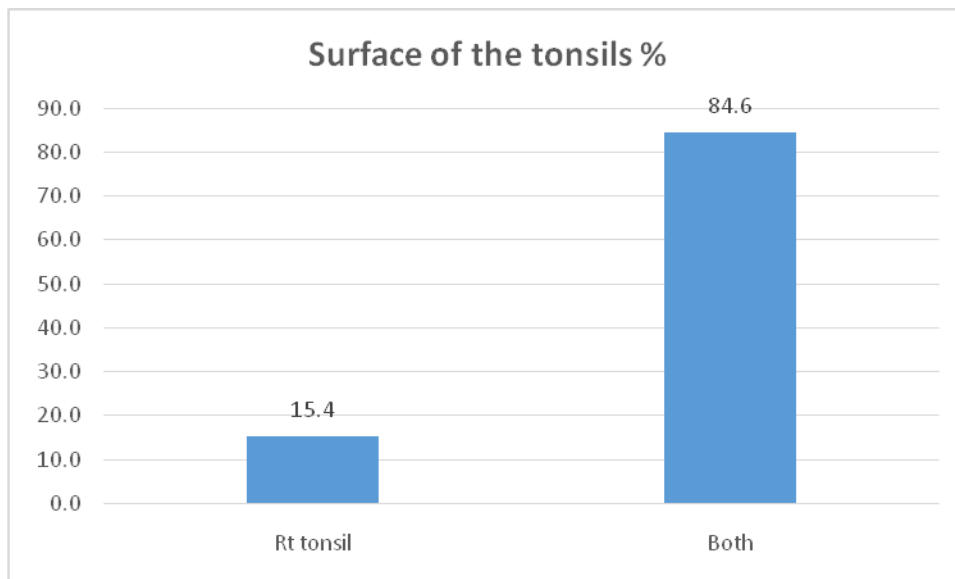


Fig: 4:12 show the surface of the tonsils in patients prone to laser tonsillectomy.

v) Color of the tonsils

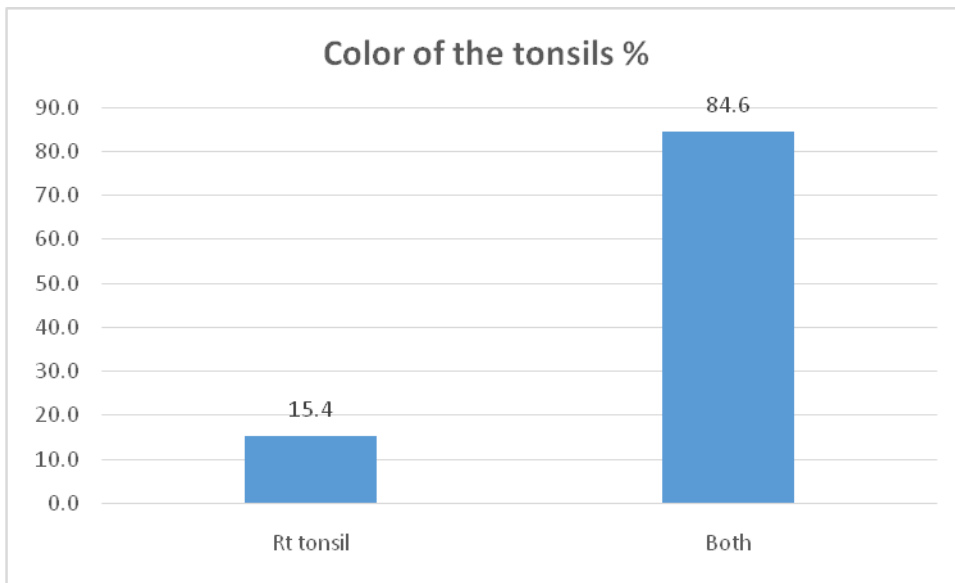


Fig: 4:13 show the color of the tonsils in patients prone to laser tonsillectomy.

vi) Smell of the mouth

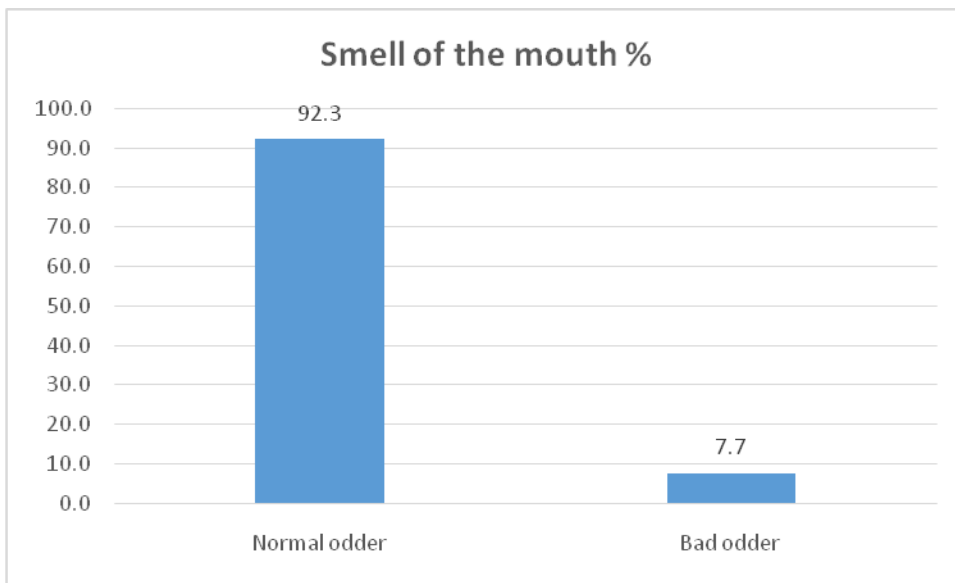


Fig: 4:14 show the change of the mouth smell in studied group.

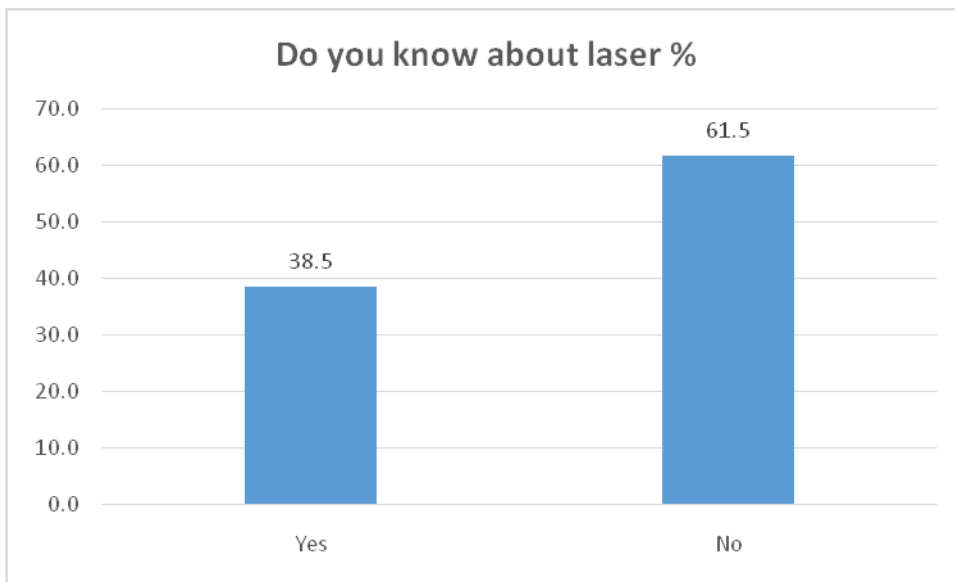


Fig: 4:15 show the knowledge of studied population about laser.

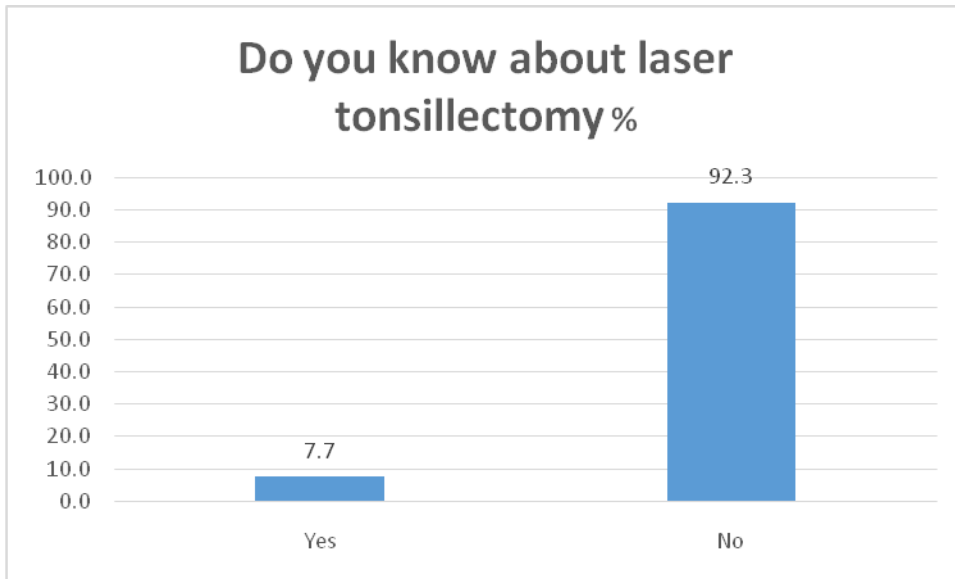


Fig: 4:16 show the knowledge of studied population about laser tonsillectomy.

Tab: 4:2 show What the patient prefer; classical or laser tonsillectomy.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Classical	1	7.7	7.7	7.7
	Laser	12	92.3	92.3	100.0
	Total	13	100.0	100.0	

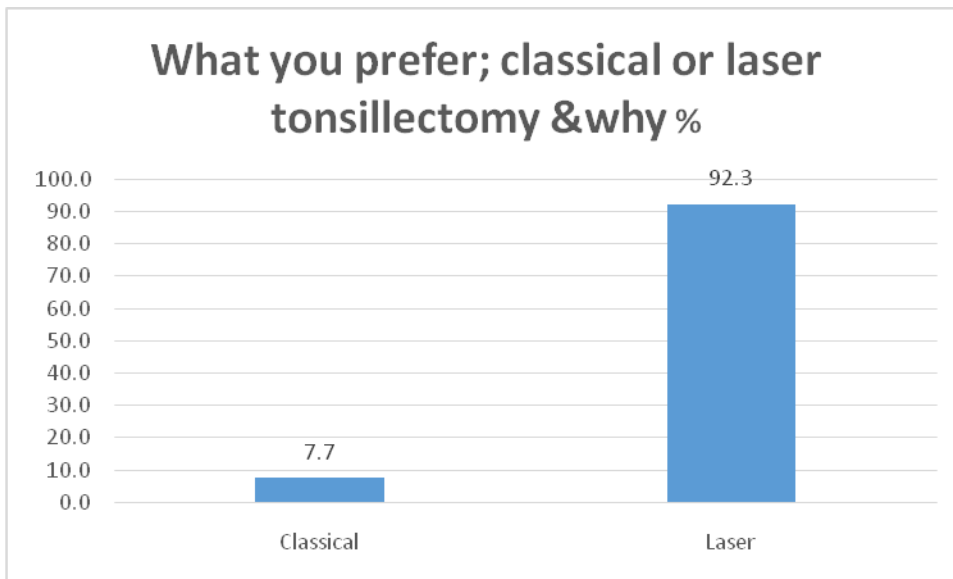


Fig: 4:17 show what the studied population prefer

Procedure of the operation:

i) Type of anasthia

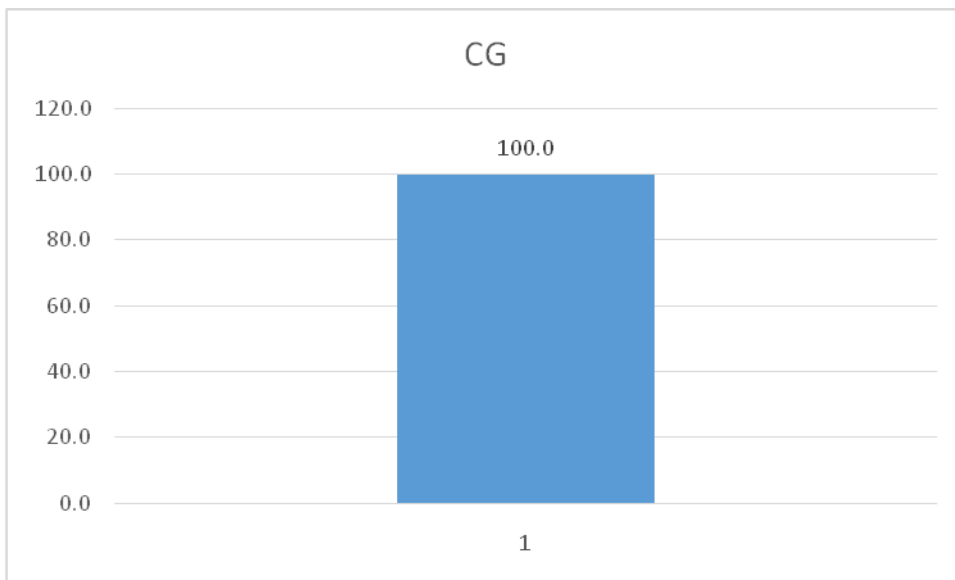


Fig: 4:18 shows the type of anesthesia used in laser tonsillectomy.

ii) Type of operation

Tab: 4:3 show the type of operation in patients prone to laser tonsillectomy.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bilateral tonsillectomy	12	92.3	92.3	92.3
	Unilateral tonsillectomy_RT side	1	7.7	7.7	100.0
	Total	13	100.0	100.0	

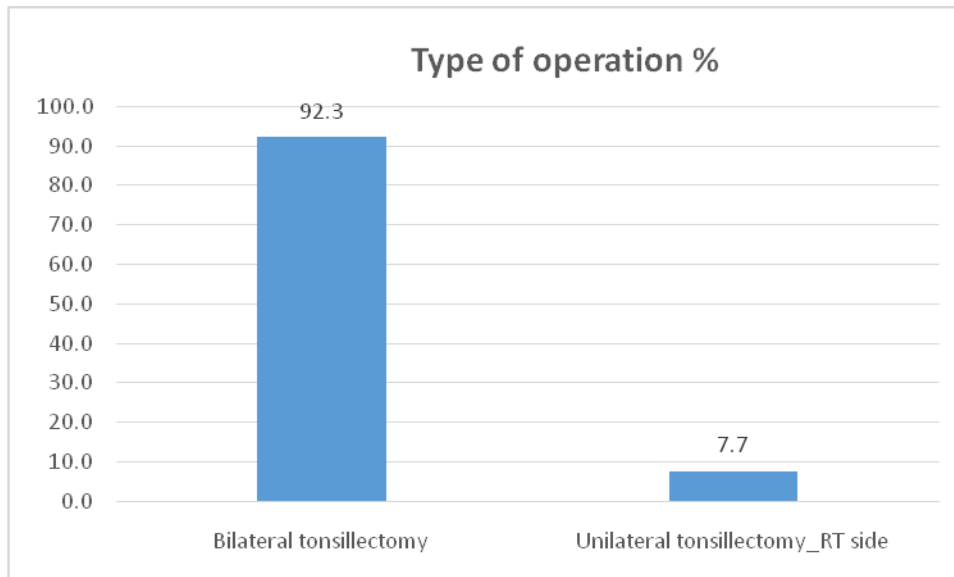


Fig: 4:19 show the type of operation done in laser tonsillectomy.

iii) Bleeding

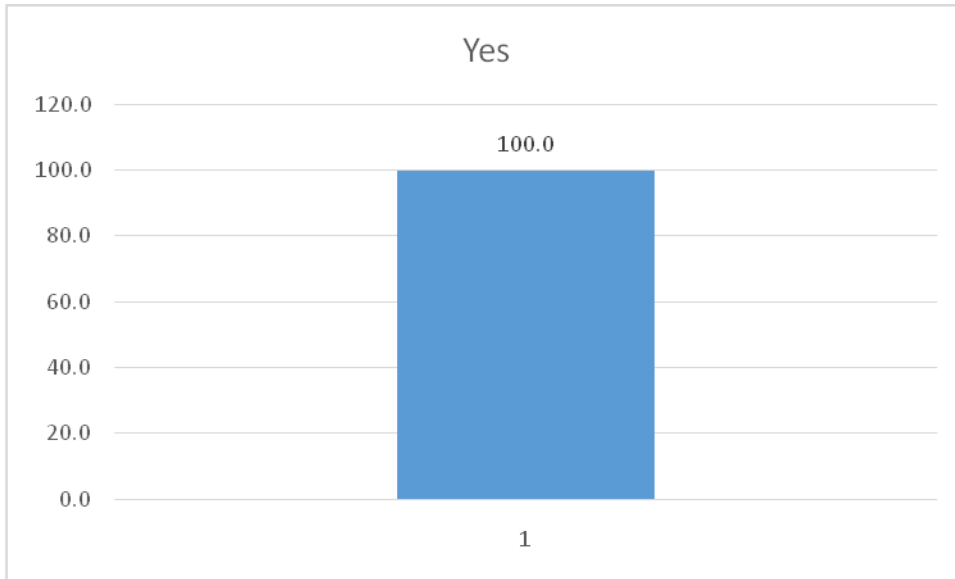


Fig: 4:20 show the intraoperative bleeding in patients prone to laser tonsillectomy.

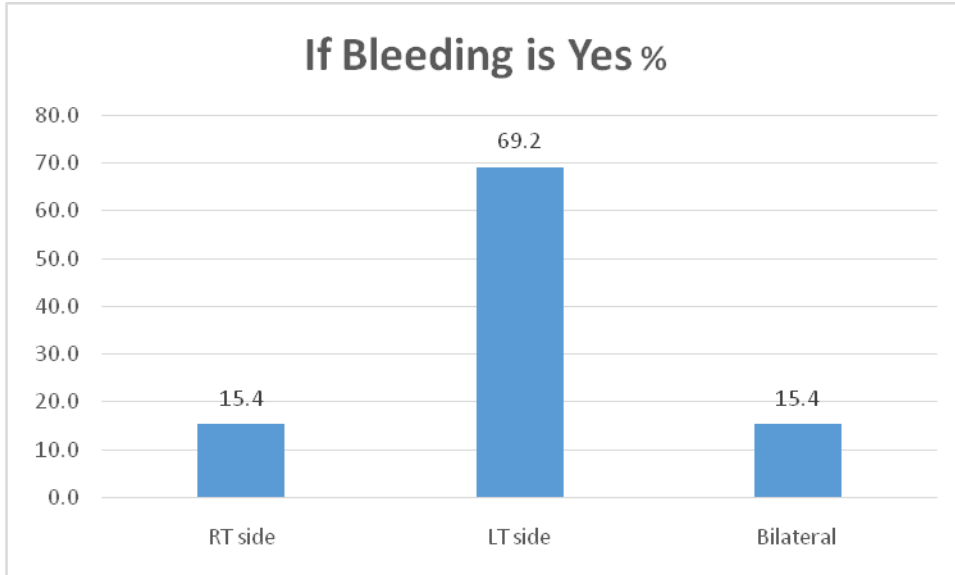


Fig: 4:21 show the side of bleeding in patients prone to laser tonsillectomy.

***The amount of blood**

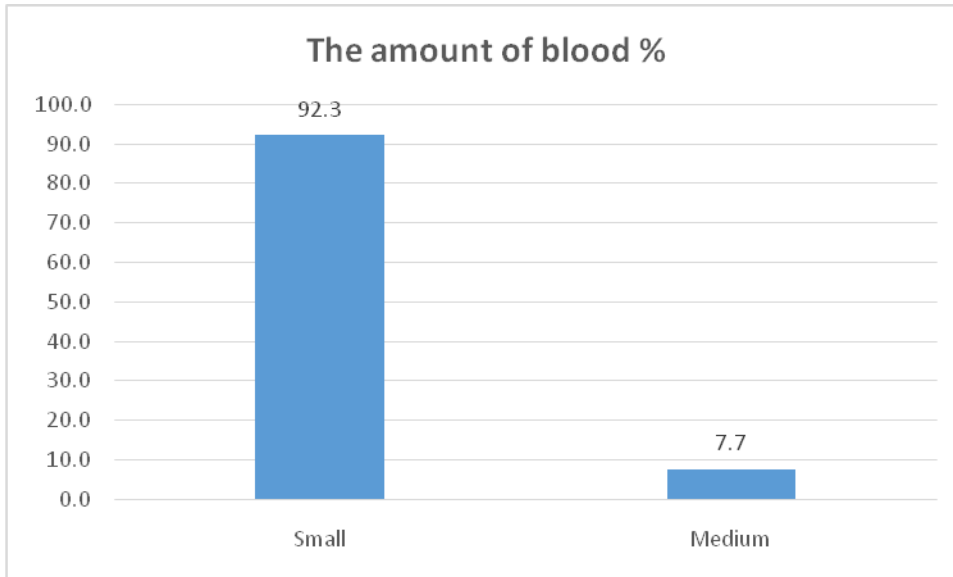


Fig: 4:22 show the amount of blood loss in patients prone to laser tonsillectomy.

Recovery from anesthesia

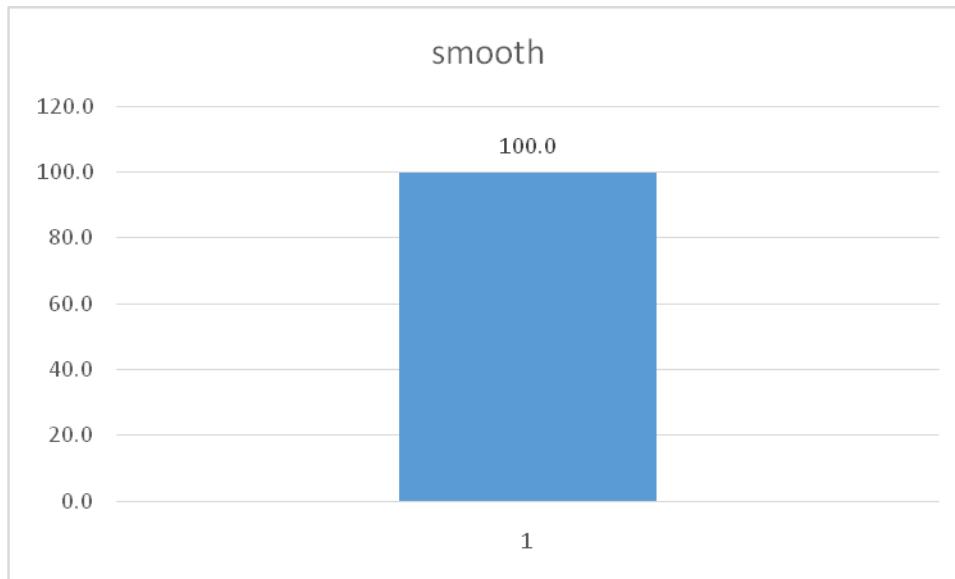


Fig: 4:23 shows the recovery from anesthesia group in patients prone to laser tonsillectomy.

Tab: 4:4 shows the Post-operative Pain

			Pain		Total
			Yes	No	
Weeks	1st Week	Count	6	7	13
		% within Weeks	46.2%	53.8%	100.0%
	3rd Week	Count	1	12	13
		% within Weeks	7.7%	92.3%	100.0%
	6th Week	Count	1	12	13
		% within Weeks	7.7%	92.3%	100.0%
Total		Count	8	31	39
		% within Weeks	20.5%	79.5%	100.0%

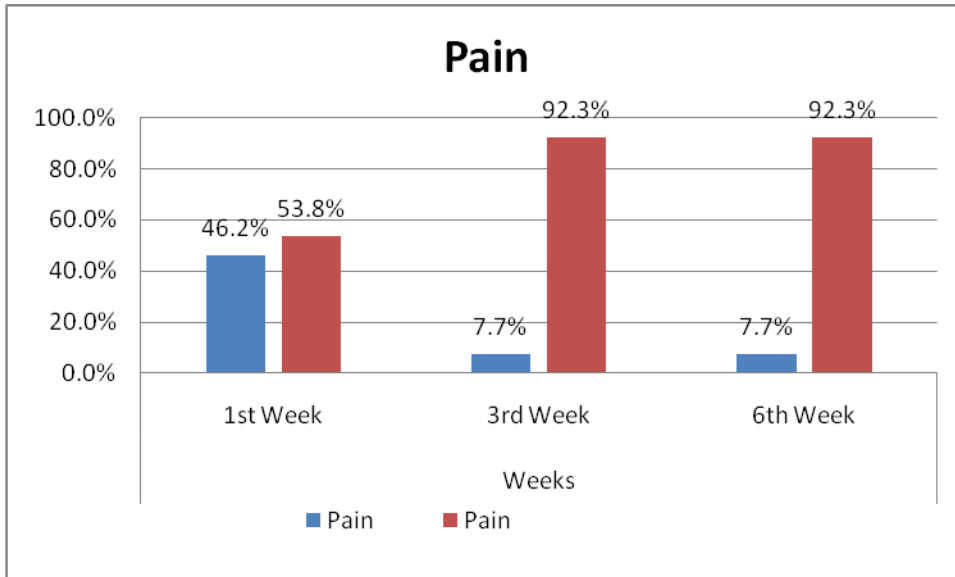


Fig: 4:24 shows less post-operative pain in patients prone to laser tonsillectomy.

1st Week

Tab:4:5 shows the post-operative bleeding

			bleeding	
			No	Total
Weeks	1st Week	Count	13	13
		% within Weeks	100.0%	100.0%
	3rd Week	Count	13	13
		% within Weeks	100.0%	100.0%
	6th Week	Count	13	13
		% within Weeks	100.0%	100.0%
Total		Count	39	39
		% within Weeks	100.0%	100.0%

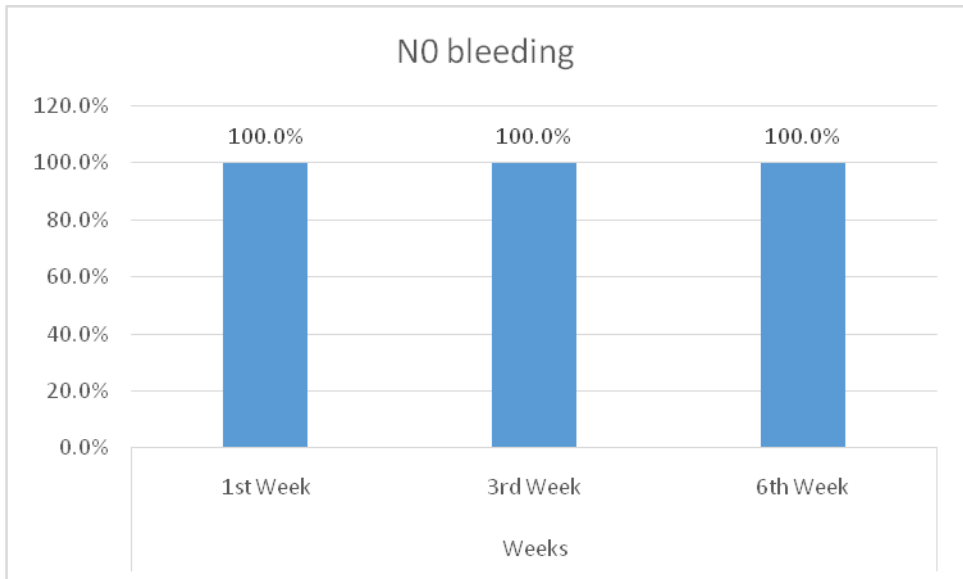


Fig: 4:25 shows the no bleeding in patients prone to laser tonsillectomy during the study period.

Tab:4:6 shows the post-operative oral intake

			Eating		Total
			Yes	No	
Weeks	1st Week	Count	10	3	13
		% within Weeks	76.9%	23.1%	100.0%
	3rd Week	Count	13	0	13
		% within Weeks	100.0%	0.0%	100.0%
	6th Week	Count	13	0	13
		% within Weeks	100.0%	0.0%	100.0%
Total		Count	36	3	39
		% within Weeks	92.3%	7.7%	100.0%

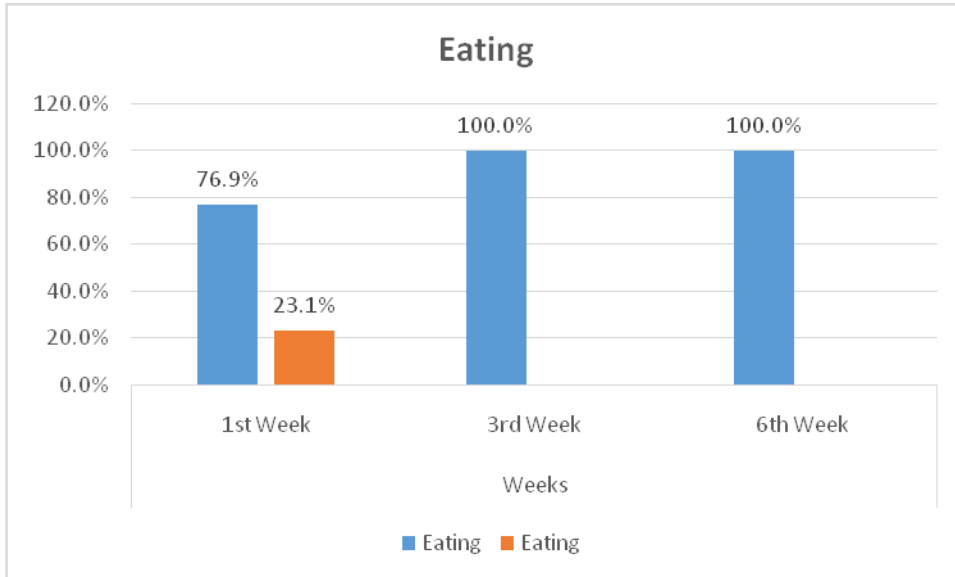


Fig: 4:26 shows the oral intake in patients prone to laser tonsillectomy.

Tab:4:7 shows no post laser tonsillectomy Infection:

			Infection	Total
			No	
Weeks	1st Week	Count	13	13
		% within Weeks	100.0%	100.0%
	3rd Week	Count	13	13
		% within Weeks	100.0%	100.0%
	6th Week	Count	13	13
		% within Weeks	100.0%	100.0%
Total		Count	39	39
		% within Weeks	100.0%	100.0%

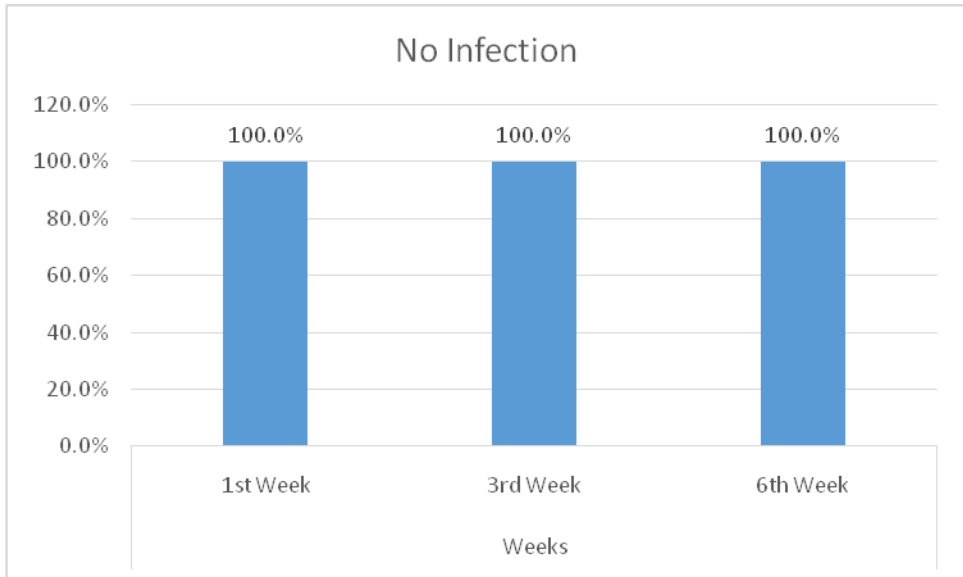


Fig: 4:27 shows there was no post-operative infection age in patients prone to laser tonsillectomy.

Tab4:8 shows the post laser tonsillectomy Healing:

			Healing		Total
			Yes	No	
Weeks	1st Week	Count	10	3	13
		% within Weeks	76.9%	23.1%	100.0%
	3rd Week	Count	13	0	13
		% within Weeks	100.0%	0.0%	100.0%
	6th Week	Count	13	0	13
		% within Weeks	100.0%	0.0%	100.0%
Total		Count	36	3	39
		% within Weeks	92.3%	7.7%	100.0%

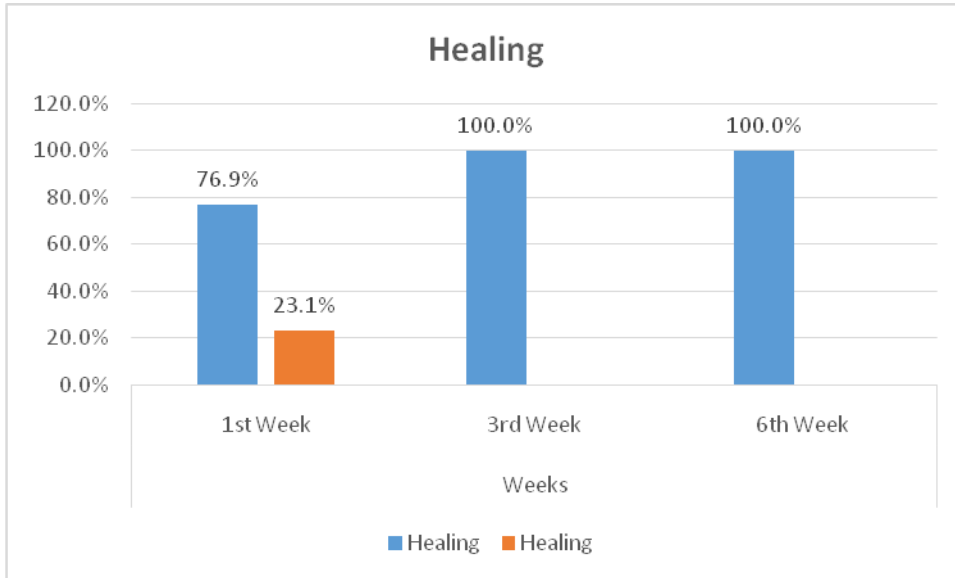


Fig: 4:2 8shows the healing in patients prone to laser tonsillectomy.

Chapter 5

Conclusion and Recommendation

4.1 Conclusion

From this study we can conclude that:

- Diode laser is safe and effective in tonsillectomy.
- Laser tonsillectomy is not takes a lot of operative time.
- Laser tonsillectomy is has a less bleeding, intra operative, post-operative.
- Laser tonsillectomy is has a minimum post -operative complication.
- Laser tonsillectomy is less post-operative pain.
- Laser tonsillectomy has early oral intake and
- Laser tonsillectomy has a good healing.

4.2 Recommendation

From this study we recommend that:

- Encourage laser tonsillectomy.
- Farther study with a larger number of patients to insure and obtain acquired results.
- To introduce laser system in any ENT hospital or department.

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Appendix;

- **Questioner**

University of Sudan for Science & Technology

Institute of Laser

Questioner

Laser tonsillectomy

By

Abusufian Hassan Ahmed Elhaj

Name.....

Index No.....

Age.....

Contact No.....

Sex.....

.....

Occupation.....

File

No.....

Residence.....

Complains:

a) **Symptoms;**

i) **Sore throat** **yes.....**

No.....

if yes; frequency per year.....

ii) **Fever.....** **yes.....**

No.....

- | | | |
|------------------------------|----------|---------|
| iii) URTI | yes..... | No..... |
| iv) Snoring | yes..... | No..... |
| v) Apnea..... | yes..... | No..... |
| vi) Difficult of swallowing. | Yes..... | No..... |
| vii) Mouth breathing | yes..... | No..... |
| viii) Mouth bleeding | yes..... | No..... |
| ix) Change of voice | yes..... | No..... |
| x) Halitosis | yes..... | No..... |

Others

.....

b) Signs;

i) size of the tonsils

Rt tonsil

Lt tonsil

Both

ii) Texture of the tonsils

Rt tonsil

Lt tonsil

Both

iii)A symmetry of the tonsil

Rt tonsil

Lt tonsil

iv) Surface of the tonsils

Rt tonsil

Lt tonsil

Both

v) Color of the tonsils:

Rt tonsil

Lt tonsil

Both

vi) Smell of the mouth

Normal odour

Bad odour

Do you know about laser?

yes.....

No.....

Do you know about laser tonsillectomy?

yes.....

No.....

What you prefer; classical or laser tonsillectomy & why?

Classical Laser

Procedure of the operation:

i) Type of anaesthesia

LA

GA

Sedation.....

ii) Type of operation:

1. Bilateral tonsillectomy

2. Unilateral tonsillectomy.....

a. RT side.....

b. LT side.....

c. Tonsillotomy.....

d. UPPP.....

iii) Bleeding

Yes.....

No.....

*If Yes

a. RT side.....

b. LT side.....

c. Bilateral

*The amount of blood:

a. Small

b. Medium

c. Large

Recovery from anaesthesia:

a. smooth.....

b. difficult.....

c. not.....

Post operative :

*1st week

i) Pain Yes.....

No.....

*If Yes mild moderate sever

ii) bleeding Yes.....

No.....

*If Yes mild moderate sever

iii) Eating Yes.....

No.....

Smooth difficult

iv) Infection Yes.....

No.....

v) Healing Yes..... No.....

***3st week**

i) Pain Yes..... No.....

*If Yes mild moderate sever

ii) bleeding Yes..... No.....

*If Yes mild moderate sever

iii) Eating Yes..... No.....

smooth difficult

iv) Infection Yes..... No.....

v) Healing Yes..... No.....

***6st week**

i) Pain Yes..... No.....

*If Yes mild moderate sever

ii) bleeding Yes..... No.....

*If Yes mild moderate sever

iii) Eating Yes..... No.....

smooth difficult

iv) Infection Yes..... No.....

v) Healing Yes..... No.....