American Journal of BioMedicine
AJBM 2014;2(3): 116–125
Research Article doi: 10.18081/2333-5106/014-07/160-169

Using a 980 nm, 7w/cm2 Diode Laser in Oral Surgeries

Shady A. M. Negm*

Abstract

At this paper, we discussed the use of laser in oral surgeries. The aim of this discussion and study were to verify the reliability and efficacy of one of these compact portable diode instruments, emitting a maximum power density of 7W/cm^2 not requiring pre-warming or controlling, and delivering a wavelength of 980 nm. In addition to that we compared between the healing time of some cases were treated by diode laser. Recently, laser is one of the most common surgical procedures in the field of oral surgery, implant dentistry, endodontic treatment as well. The role of laser surgery in the oral cavity is well established. The use of diode laser removing a haemangioma as special case is currently under investigation. The benefits of oral laser surgery are many benefits i.e., a relatively bloodless surgical and postsurgical course, minimal swelling and scarring and reduction of post-surgical pain are discussed. An interesting cases of removal of a haemangioma, fibroma and performin a frenectomy with a 980 nm diode laser are presented.

Key words: Diode laser, oral surgery, haemangioma, fibroma, frenectomy

*Corresponding author email: smngm@msn.com
[1]Faculty of Dentistry, Pharos University, Egypt. T: +201002944111
Received February 22, 2014; Accepted May 28, 2014, Published July 14, 2014

Introduction

Laser technology is developing very quickly. An instrument achieves maximum oral health in a minimally invasive fashion. New Lasers with a wide range of characteristics are available today and are being used in the various fields of medicine and dentistry. The search for new devices and technologies for dental procedures was always challenging and in the last two decades, much experience and knowledge have been gained. Applications now are being developed for a broader range of wavelengths that will offer useful, predictable, and comfortable therapy for managing of dental patients. Particularly, the use of a diode laser seems to be promising, in patients, who need to be treated with a technique where the operative and post-operative blood loss and post-operative discomfort are reduced.

The clinician has to decide which technique is medically superior for his patients. In the cases we described below, the use of diode laser was preferred. We use the diode laser with wavelength 980 nm to remove haemangioma, fibroma and to treat the low attachment of

Research Article doi: 10.18081/2333-5106/014-07/160-169

frenum. The actual procedure takes 4-6 minutes; the healing period of 10 - 15 days was found to be uneventful. The use of diode laser was preferred in order to avoid any painful needle injection even if the clinician needs more time to complete the surgery procedure. The whole procedure was performed without pain. However, homeostasis was optimum immediately surgeries. In addition, no sutures are required and the risk of a post-operative infection is limited. In general, the advantages of lasers include a relatively bloodless field with minimally swelling and scarring. Coagulation and cutting is minimal or no need for suturing. Reduction in surgical time occurred when infiltrated anesthesia was used, no pain during and after surgery. Using the Dental surgical diode laser 980 nm-7 W (DENLASE-980/7) as seen in figure [1], with the dental laser hand pieces as seen in figure [2].

Figure 1. Dental surgical diode laser 980 nm - 7 W (Model: DENLASE - 980/7)

Figure 2. Dental laser hand pieces

Case report No.1 Haemangioma

A 39 years old female with a bloody mass in the lower surface of tongue with the floor of the mouth was referred to us for case evaluation. Patient complains a pain in the oral cavity. Haemangioma are the most common benign vasoformative tumours of adults. They usually are manifested within the life, exhibit a rapid proliferative phase, and slowly involute to near complete resolution. There are many ways to classify haemangiomas. Haemangiomas are broadly classified into capillary, cavernous, and miscellaneous forms like verrucous, venous, arteriovenous haemangiomas, and so forth. Capillary haemangiomas further include juvenile, pyogenic granuloma, and epitheliod haemangioma. The term haemangioma has been commonly misused to describe a large number of vasoformative tumors. However, the ISSVA has recently provided guidelines to differentiate these two conditions, according to the novel classification first published by Mulliken et al. in 1982. Vasoformative tumours are broadly classified into two groups: haemangioma and vascular malformation. Haemangioma is histologically further classified into capillary and cavernous forms. Capillary haemangioma is composed of many small capillaries lines by a single layer of endothelial cells supported in a connective tissue stroma of varying density, while cavernous haemangioma is formed by large,

Research Article doi: 10.18081/2333-5106/014-07/160-169

thin walled vessels, or sinusoids lined by epithelial cells separated by thin layer of connective tissue septa. The majority of haemangioma involve the head and neck. However, they are rare in the oral cavity but may occur on tongue, lips, buccal mucosa, gingiva, palatal mucosa, salivary glands, alveolar ridge, and jawbones.

Clinically, haemangioma appears as soft mass, smooth or lobulated, and sessile or pedunculated and may vary in size from a few mms to several cms. They are usually deep red, may blanch on the application of pressure, and if large, might interfere with mastication. In the present case study, we report a rare and an unusual case of capillary haemangioma of the palatal mucosa. Haemangiomas are usually harmful in late stages, and treatment is necessary required in cases where there are unusual symptoms or for cosmetic concerns because it may transfer into malignant form. The treatment of choice is surgeries; nowadays we use a soft tissue laser to remove such a lesion. We will discuss the usage and benefits of laser later on. As we know that all benign tumor made up mostly of connective tissue mainly blood, fibers etc. vascular anomalies comprise a widely heterogeneous group of tumors and malformations.

Haemangioma is the most common benign tumor of vascular origin of the head and neck region. The possible sites of occurrence in oral cavity are lips, tongue, buccal mucosa, and palate. Despite its benign origin and behavior, it is always of clinical importance to the dental profession and requires appropriate management. The main symptom is the presence of a mass, which is tender. Patients complain of sensitive to the touch, and the color may change over time. If it is irritated or damaged, it may bleed as it has a raised surface. Haemangiomas are harmful, and treatment is necessary required. Therefore, we should know everything about the lesion before surgeries take place.

Description of the lesion as seen in case No. 1

Distribution: one ventral surface of the tongue and the floor of the mouth.

Size: 2.2 inch 1.9 inch

Site: Intra-orally lesion at ventral surface of the tongue and the floor of the mouth.

Surface morphology: Multiple balls-like and Irregular in shape.

Color: Reddish

Consistency: Fluctuant and bleed easily upon probing.

Pain: painful

Prior history: Since 2005 till 2012, the lesion has the same size.

With our examination, the extra-oral examination overview is normal, and the intra-oral examination reveals Soft tissues structures, which are normal except the mass in the ventral surface of the tongue and the floor of the mouth as seen in figure [3] & [4].

Research Article doi: 10.18081/2333-5106/014-07/160-169

Case report No. 2 Fibroma

A 65 years old man with a fibrotic mass in the inner surface of left check was referred to us for case evaluation. Patient complains a pain with itching sensation in inner left check areas of the oral cavity. Patient told us that the itch started from a long period. Fibroma can be found anywhere in the body and usually do not require treatment or removal because it is a benign tumor made up mostly of connective tissue mainly fibers. It develops when uncontrolled cell growth occurs for an unknown reason, or because of injury or irritations, which is locally occurred. The main patient's symptoms are the presence of a mass, which is not tender. Patients complain of itchy or sensitive to the touch, and the color of it changed over time. If it is irritated or damaged, it may bleed as it has a raised surface. The causes of fibroma are not clearly known. Some researchers believe that fibroma may form following a minor injury.

Fibroma may have a genetic component "people of northern European". Some medications including beta-blockers have been reported to cause changes in fibrotic tissue. No risk factors are definitely mentioned have been associated with either fibroma, but some suspected risk factors include A) Family history of fibroma. B) Northern European race. Fibromas are usually harmless, and treatment is not necessary required except in cases where there are unusual symptoms or for cosmetic concerns. The treatment of choice is surgeries; nowadays we use a soft tissue laser to remove such a lesion. With our examination, the extraoral examination overview is normal, and the intra-oral examination reveals soft tissues structures, which are

Figure 3.
The haemangioma mass in the floor of the mouth

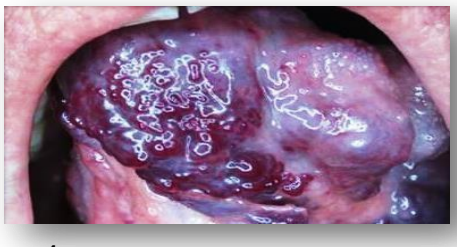


Figure 4.
The haemangioma mass in the ventral surface of the tongue

Research Article doi: 10.18081/2333-5106/014-07/160-169

normal except the mass in the inner left cheek as seen in figure [5] and see the figures [6], [7] and [8].

Description of the lesion and seen in case No. 2

Distribution: one left isolated mass

Size: 1.2 inch 0.7 inch

Site: Intra-orally lesion at inner surface of left cheek

Surface morphology: Smooth ball-like and regular in shape

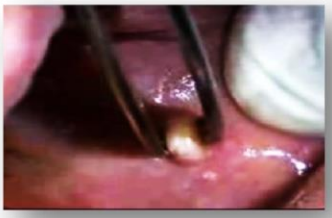
Color: Pinkish

Consistency: Rubbery

Pain: painless

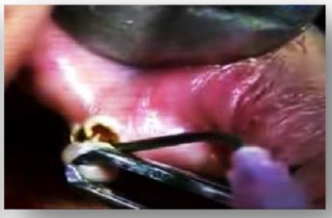
Prior history: Since 2006 till 2012, the lesion has the same size

Figure 5



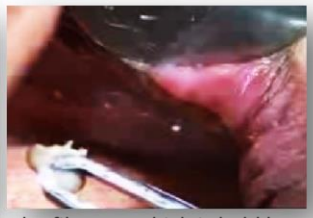
lesion fibroma by a diode laser.

Figure 6 (middle).



The removal of the mas founded in the inner surface of the left cheek.

Figure 7



The fibroma which is held by a tissue forceps after removal.

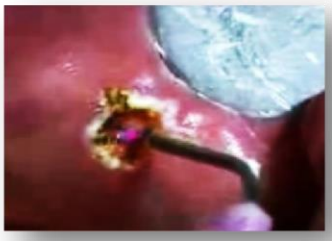


Figure 8.
(before surgery).

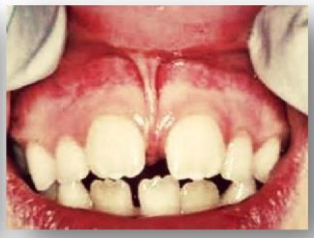


Figure 9.
The removal of the fibroma by a diode laser.

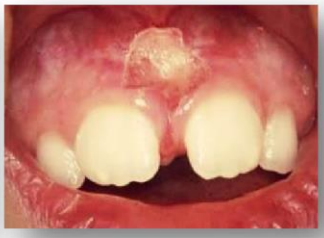


Figure 10.
The low attach of labial frenum

The targeted tissues showing bloodless field (during procedure).

Case report No. 3 Frenectomy

The 11 years old Egyptian male child with low labial frenum attachment complaining of inability to which is medically of insignificance. Frenum or frenulum in the oral cavity is mucosal fold in the labial buccal and lingual surfaces of alveolar mucosa. The frenum which attaching the tongue to the base of the mouth is the lingual frenum while the labial frenum is the tight mucosal fold that attach the upper lip to the gums. The labial frenum should be attached at least 4 mm above the gum crest of the front teeth and should not limit the lip movements. The general

Research Article doi: 10.18081/2333-5106/014-07/160-169

consequences of a low-attaching frenum, especially in children are: midline diastema (spacing between two central incisors with orthodontic and aesthetic problem), periodontal inflammation and consequently gingival recession and the tight folds limits lip's function and prevents it from adapting with the lower lip, or forming lip seal, leads to open mouth. In such a case surgery for its removal is indicated. The conventional ways is the use of scalpel with different surgical techniques while the new technology is laser as we did.

Labial Frenectomy

When the tissue that is attached to the center of the upper lip on the inside of the mouth is clipped or removed, it is called a labial frenectomy. The treatment choices are surgery (with scalpel and other surgical instruments) as an old technique or laser (soft tissue laser) as a new technology. The extra-oral examination shows no abnormality detected, and the intra-oral examination with no abnormality detected except low attachment of upper labial fremum with spacing between two upper central incisors as seen in figure [9] and [10].

Discussion Laser as a new technology

Lasers emit a precise beam of concentrated light energy. This light is unique in that it is comprised of a single wavelength, expressed in nanometers. The wavelength generated is based on the active medium present in the laser device and can be a solid (diode) or gas (CO2 or Argon). The diode laser is considered a solid, with a semiconductor chip embedded with crystals, making the device smaller and lighter. The active medium determines the wavelength, varying by the makeup of the crystals. The wavelengths divided into visible and invisible wavelengths from 532 nm in visible area to 1550 nm, we always use wavelengths that near infrared spectrum, typically from 800 nm to 980 nm. The wavelength determines the absorption characteristic in biologic tissues. Absorption of laser light by biologic tissue determines efficiency of surgical removal. The various components of the biologic tissue determine whether laser light will be absorbed. Diode lasers are well-absorbed by hemoglobin and pigmented tissue. Different wavelengths are absorbed by soft tissue at varying rates, depending on the type of soft tissue. Keratinized tissues, containing less blood, require the use of lasers with higher wavelengths or the use of more power in general. The practitioner must match the wavelength to the specific tissue, because specific wavelengths provide great precision, minimizing potential risk of lateral tissue damage.

Interaction of the laser with tissue is a photo-thermal event, in which light is transformed into heat. When the laser beam penetrates tissue and is absorbed, a designated amount of energy is removed per unit of time, with a resultant temperature rise. Coagulation begins at over 50°C, with protein denaturation at 60°C. At temperatures 100°C, vaporization of water occurs. At 150 C carbonization of tissue and 300 C melting of tissues occur. Laser surgery is achieved by the process of ablation, removing this tissue by converting it to a gaseous state or plume. The plume is considered a biohazard and should be removed with high-volume evacuation. The power output utilized by the soft-tissue diode laser is typically between .1 and 10 watts or joules

per second, in a continuous output or a pulsed power. Diode lasers use optical fibers to deliver the laser beam. A pencil-size hand-piece glides over the fiber and locks into place. Most treatment uses direct contact with the tissue and allows the operator to experience tactile feedback similar to a scalpel or mechanical instrument.

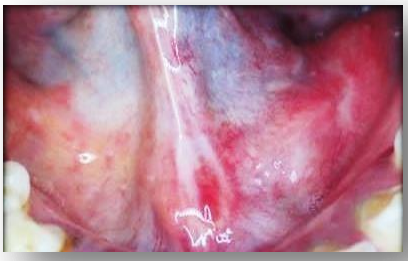
Several researchers refer to the clinical uses for lasers with the aim of bringing the laser to the dental practitioner to improve dental care. Currently, soft tissue applications have constituted the primary area for the clinical use of lasers in dentistry. The safety and efficacy of laser systems and especially the diode laser is already evaluated for the treatment of oral surgery for example upper and lower frenulectomy, fibroma and excision of epulis fissuratum, gingival hyperplasia and others.

The greatest risk of using laser is injuries to eyes, in which cases retinal damage can take place since wavelength of diode laser is between 532 nm and 1550 nm (called the retinal hazard region). Even a stray laser beam reflected from a table, jewelry or a belt could lead to retinal burns and cataracts. Laser radiation may also pose a danger to skin. The patient and the staff should therefore be fully covered and wear protective goggles at all times. Moreover, the laser results in a fire hazards if the beam contact flammable substances, necessitating the availability of flame-retardant materials. Thus, gauze sponges used for charred tissues debridement should be saturated with water, not alcohol.

Results

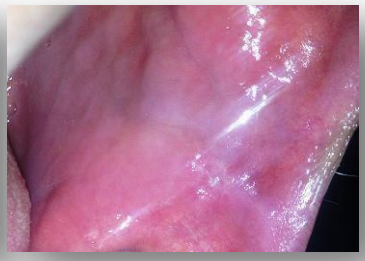
The healing of tissues treated by laser is faster than scalpel surgery, the healing period of 10 - 15 days was found to be uneventful. The healing period of treated cases was as followings: Haemangioma 15 day's figure [11], Fibroma 10 day's figure [12] and Frenectomy 12 days figure [13].

Figure 11



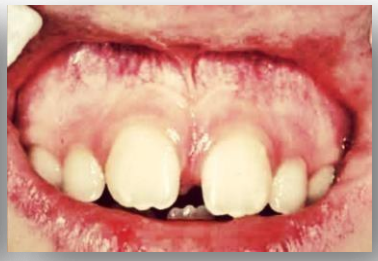
The ventral surface of the tongue
The inner surface of left cheek after 10 days' Removal of a fibroma.

Figure 12



the floor of the mouth after 15 days of lesion removal.

Figure 13



The attach of labial frenum after 12 days.

At the 4-week follow-up, the case had completely healed without scarring. There were no infections. The patients were satisfied with the treatment and the results obtained. In oral surgical procedures, no hemorrhage was observed either during treatment or during the healing

period. No sutures were required. The patient was comfortable with no pain, either intraoperatively or post-operatively. Hemostasis was optimum immediately after the procedure. Ten days later the procedure, each healing was found to be uneventful.

Conclusions

Use of lasers in general dentistry is now an accepted and to some extent, expected treatment modality. Laser use can be an adjunct to either other procedures or the main form of treatment itself. For many procedures, lasers are now becoming the treatment of choice by both clinicians and patients, and in some cases, the standard of care. Clinicians need to learn more about constantly updated technology and apply newly discovered methods and protocols to clinical situations to benefit patients and clinicians.

Diode lasers contribute significantly to the field of oral surgery providing an invaluable resource for clinicians who perform treatment of soft tissue issues. Diode laser provides benefit to dental patients and professionals and is very useful in surgical dental procedures. The use of diode laser seems to be promising in patients who need to be treated with a technique where the operative and post-operative blood loss and post-operative discomfort are reduced. In addition, pain perception is an important issue in creating guidelines for surgical procedures.

If a clinician decides to use a laser for a dental procedure, he needs to fully understand the character of the wavelength being used, and the thermal implications and limitations of the optical energy. This minimally invasive laser-assisted were accomplished with minimal anesthesia, minimal discomfort, no sutures, no antibiotics, and great patient satisfaction. In these cases, we used the diode laser with wavelength 980 nm to treat the cases. The actual procedure took 4-6 minutes, and full healing with new tissues was evident within 10-15 days.

Abbreviations

ISSVA: International Society for the Study of Vascular Anomalies

Consent

Written informed consent was obtained from the patient for publication of this case report, and any accompanying images.

References

1. Adhikary S, Marinoni F, Hock A, et al. The ubiquitin ligase HectH9 regulates transcriptional activation by Myc and is essential for tumor cell proliferation. Cell. 2005;123:409–421.
2. Ahmadiyeh N, Pomerantz MM, Grisanzio C, et al. 8q24 prostate, breast, and colon cancer risk loci show tissue-specific long-range interaction with MYC. Proc Natl Acad Sci U S A. 2010;107:9742–9746.
3. Arvanitis C, Felsher DW. Conditional transgenic models define how MYC initiates and maintains tumorigenesis. Semin Cancer Biol. 2006;16:313–317.

4. Beer S, Zetterberg A, Ihrie RA, et al. Developmental Context Determines Latency of MYCInduced Tumorigenesis. PLoS Biol. 2004;2:E332.
5. Brodeur GM, Seeger RC, Schwab M, Varmus HE, Bishop JM. Amplification of N-myc in untreated human neuroblastomas correlates with advanced disease stage. Science. 1984;224:1121–1124.
6. Challagundla KB, Sun XX, Zhang X, DeVine T, Zhang Q, Sears RC, Dai MS. Ribosomal protein L11 recruits miR-24/miRISC to repress c-Myc expression in response to ribosomal stress. Mol Cell Biol. 2011;31:4007–4021.
7. Chesi M, Robbiani DF, Sebag M, et al. AID-dependent activation of a MYC transgene induces multiple myeloma in a conditional mouse model of post-germinal center malignancies. Cancer Cell. 2008;13:167–180.
8. Cowling VH, Chandriani S, Whitfield ML, Cole MD. A conserved Myc protein domain, MBIV, regulates DNA binding, apoptosis, transformation, and G2 arrest. Mol Cell Biol. 2006;26:4226–4239.
9. Dai J, Carver M, Hurley LH, Yang D. Solution Structure of a 2:1 Quindoline-c-MYC GQuadruplex: Insights into G-Quadruplex-Interactive Small Molecule Drug Design. J Am Chem Soc. 2011;133:17673–17680.
10. Andreadi C, Cheung LK, Giblett S, et al. The intermediate-activity (L597V)BRAF mutant acts as an epistatic modifier of oncogenic RAS by enhancing signaling through the RAF/MEK/ERK pathway. Genes Dev. 2012;26:1945–1958.
11. Beverly LJ, Varmus HE. MYC-induced myeloid leukemogenesis is accelerated by all six members of the antiapoptotic BCL family. Oncogene. 2009;28:1274–1279.
12. Bollag G, Hirth P, Tsai J, et al. Clinical efficacy of a RAF inhibitor needs broad target blockade in *BRAF*-mutant melanoma. Nature. 2010;467:596–599.
13. Beaulieu ME, McDuff FO, Bedard M, Montagne M, Lavigne P. Methods for the expression, purification, preparation, and biophysical characterization of constructs of the c-Myc and Max bHLH-LZs. Methods Mol Biol. 2013;1012:7–20.
14. Sharrard RMRJ, Rogers S, Shorthouse AJ. Patterns of methylation of the c-myc gene in human colorectal cancer progression. Br J Cancer. 1992;65(5):667–72.
15. Clausen DM, Guo J, Parise RA, Beumer JH, Egorin MJ, Lazo JS, Prochownik EV, Eiseman JL. In vitro cytotoxicity and in vivo efficacy, pharmacokinetics, and metabolism of 10074-G5, a novel small-molecule inhibitor of c-Myc/Max dimerization. J Pharmacol Exp Ther. 2010;335(3):715–27.
16. Dang CV. Therapeutic targeting of Myc-reprogrammed cancer cell metabolism. Cold Spring Harb Symp Quant Biol. 2011;76:369–74.
17. Kota J, Chivukula RR, O'Donnell KA, Wentzel EA, Montgomery CL, Hwang HW, Chang TC, Vivekanandan P, Torbenson M, Clark KR, et al. Therapeutic microRNA delivery suppresses tumorigenesis in a murine liver cancer model. Cell. 2009;137(6):1005–17.
18. Wang X, Cunningham M, Zhang X, Tokarz S, Laraway B, Troxell M, Sears RC. Phosphorylation regulates c-Myc's oncogenic activity in the mammary gland. Cancer Res. 2011;71(3):925–36.
19. Meyer MJ, Das J, Wang X, Yu H. INstruct: a database of high-quality 3D structurally resolved protein interactome networks. Bioinformatics. 2013;29(12):1577–9.
20. DeBerardinis RJ, Lum JJ, Hatzivassiliou G, Thompson CB. The biology of cancer: metabolic reprogramming fuels cell growth and proliferation. Cell Metab. 2008;7(1):11–20.
21. Zeller KI, Zhao X, Lee CW, Chiu KP, Yao F, Yustein JT, Ooi HS, Orlov YL, Shahab A, Yong HC, et al. Global mapping of c-Myc binding sites and target gene networks in human B cells. Proc Natl Acad Sci U S A. 2006;103(47):17834–9.
22. Yousif NG. Fibronectin promotes migration and invasion of ovarian cancer cells through up ‐ regulation of FAK–PI 3 K/A kt pathway. Cell biology international 2014;38(1):85-91.
23. Menssen A, Hermeking H. Characterization of the c-MYC-regulated transcriptome by SAGE: identification and analysis of c-MYC target genes. Proc Natl Acad Sci U S A. 2002;99(9):6274–9.
24. Corzo C, Corominas JM, Tusquets I, Salido M, Bellet M, Fabregat X, Serrano S, Sole F. The MYC oncogene in breast cancer progression: from benign epithelium to invasive carcinoma. Cancer Genet Cytogenet. 2006;165(2):151–6.

25. Aulmann S, Adler N, Rom J, Helmchen B, Schirmacher P, Sinn HP. c-myc amplifications in primary breast carcinomas and their local recurrences. J Clin Pathol. 2006;59(4):424–8.
26. Dang CV, Kim JW, Gao P, Yustein J. The interplay between MYC and HIF in cancer. Nat Rev Cancer. 2008;8:51–56.
27. Dai J, Carver M, Hurley LH, Yang D. Solution Structure of a 2:1 Quindoline-c-MYC GQuadruplex: Insights into G-Quadruplex-Interactive Small Molecule Drug Design. J Am Chem Soc. 2011;133:17673–17680.
28. Abraham D, Podar K, Pacher M, et al. Raf-1-associated protein phosphatase 2A as a positive regulator of kinase activation. J Biol Chem. 2000;275:22300–22304.
29. Andreadi C, Cheung LK, Giblett S , et al. The intermediate-activity (L597V)BRAF mutant acts as an epistatic modifier of oncogenic RAS by enhancing signaling through the RAF/MEK/ERK pathway. Genes Dev. 2012;26:1945–1958.
30. Balasubramanian S, Hurley LH, Neidle S. Targeting G-quadruplexes in gene promoters: a novel anticancer strategy? Nat Rev Drug Discov. 2011;10:261–275.
31. Beverly LJ, Varmus HE. MYC-induced myeloid leukemogenesis is accelerated by all six members of the antiapoptotic BCL family. Oncogene. 2009;28:1274–1279.
32. Blackwood EM, Eisenman RN. Max: a helix-loop-helix zipper protein that forms a sequencespecific DNA-binding complex with Myc. Science. 1991;251:1211–1217.
33. Boone DN, Qi Y, Li Z, Hann SR. Egr1 mediates p53-independent c-Myc-induced apoptosis via a noncanonical ARF-dependent transcriptional mechanism. Proc Natl Acad Sci USA. 2011;108:632–637.
34. Cairo S, Wang Y, de Reyniès A, et al. Stem cell-like micro-RNA signature driven by Myc in aggressive liver cancer. Proc Natl Acad Sci USA. 2010;107:20471–20476.
35. Chapman PB, Hauschild A, Robert C, et al. Improved survival with vemurafenib in melanoma with BRAF V600E mutation. N Engl J Med. 2011;364:2507–2516.

American Journal of BioMedicine
Journal Abbreviation: AJBM
ISSN: 2333-5106 (Online)
DOI: 10.18081/issn.2333-5106
Publisher: BM-Publisher
Email: editor@ajbm.net