

Electronic System for Cancer Diagnosis
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Lecture – 27

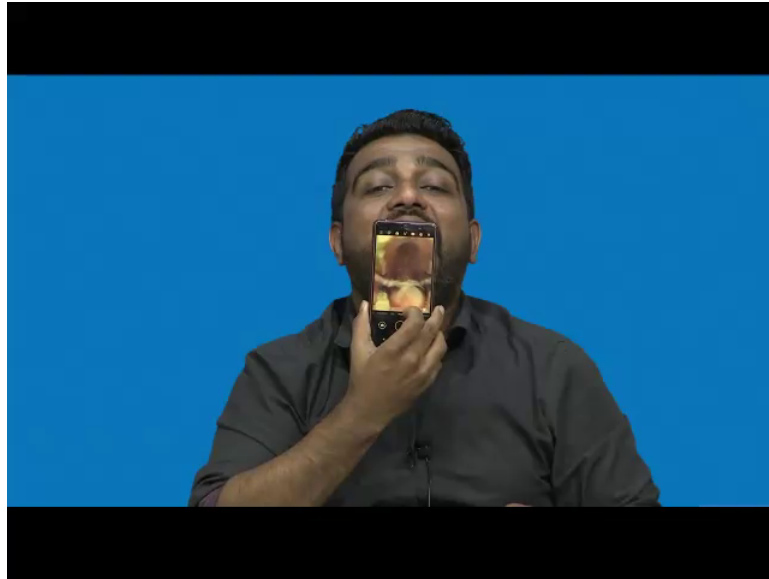
Comparative Study on diagnostic tools for oral cancer screening

Hi welcome to this module. Now, until last module what we are relying on? We are relying on the cell morphology and based on the cell morphology can we understand whether the person is suffering from cancer or not. Like we cannot still confirm until, we go for the tissue morphology that is screening operation can be done based on the cell, but to identify whether a person suffering or not we have to rely on gold standard, which is the biopsy and in biopsy, you have to take out the tissue and do the gold standard which is biomarker testing and imaging.

Now, here in today's module I want to discuss on the a device that you can develop to take the images from the oral cavity and send it to a remote specialist; a remote clinician. So, there are several the devices existing in the market and, we if we have chains I will just get the videos of those devices. So, that you understand how it is used in real life application. And we will talk about one such device that we can develop with our preexisting knowledge of electronics and systems ok.

So, when you talk about again oral cancer diagnosis, we are talking about oral cancer because we want to take images in the oral cavity. So, a system that can go within the mouth and can reach to hard to access area that the mobile cannot use say, if I use my mobile. If I take the images right, I you cannot see the image of my of some of the regions in my mouth right.

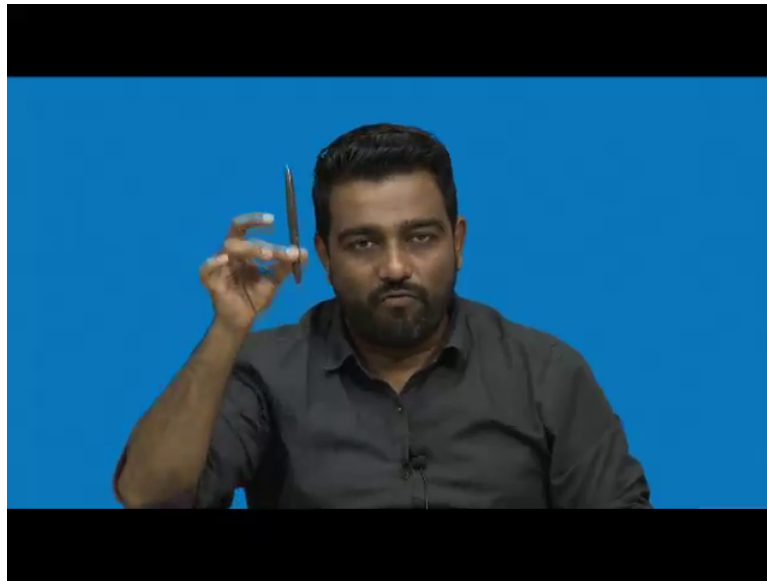
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If you see here and you see that only some of the areas you can access right, you can pull out the lip you can see only some of the areas here or so, the what I am showing you here is that I cannot go like if I have a pen. So, I have a pen I can go further within it no. So, you can use this pen or such a device instead of mobile like what happens, the semi skilled person like Asha workers, they are given mobile to take the images and send to a remote oncopathologist or remote experts clinicians but can you rely on mobile you cannot, because it cannot get the images in some of the area within the mouth right.

This is the problem and that is why we have to come up with a solution of how can we access those areas and that is the topic of today's module. So, this is visual examination or you can say lies light base detection system.

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So, can I develop a device like a pen, with my electronic mo you know system in the area grown it and I can access I can resend the pen within, it has a onboard display and so, that Asha worker can see right and it can store the images this can do the ail and lot of other stuff.

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Oral Cancer Diagnosis

Diagnostics Modalities for oral cancer detection:

- > Visual examination(Custom-built diagnostic device)
- > Excision biopsy and Histopathology
- > Oral brush biopsy (OralCDx) ✓
- > Toluidine blue ✓
- > Light-based detection systems ✓
- > Chemiluminescence ✓
- > Tissue fluorescence imaging (VELscope) ✓
- > Tissue fluorescence spectroscopy ✓
- > Biomarkers ✓
- > DNA-analysis ✓
- > Laser capture microdissection ✓

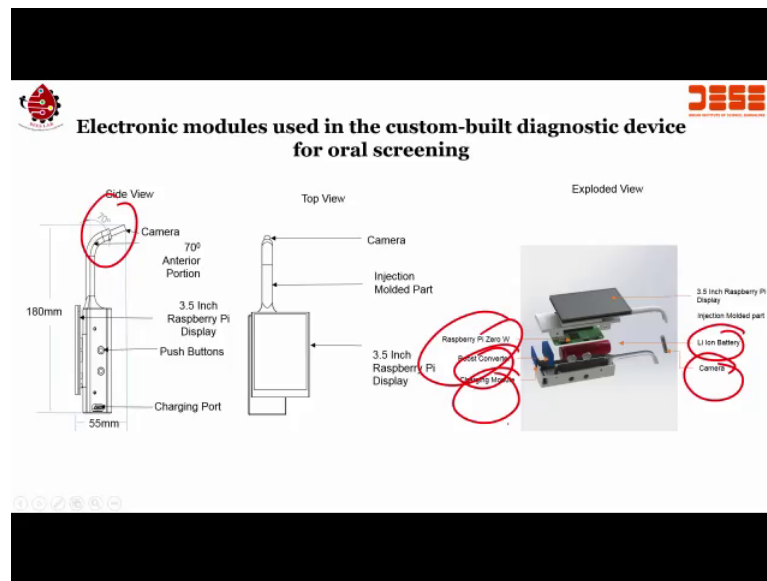
Mohotra, Ravi, and Divyendra K. Gupta. "Facilitating new advances in oral cancer diagnosis: avenues to early detection." *Head & neck oncology* 3, no. 1 (2012): 33.

So, if I if you see the screen we are talking about diagnosing the oral cancer and visual examination, which is cus some built diagnostic device the there can be excision biopsy and histopathology right that we know oral brush biopsy we have seen, there can be a

toluidine blue there is another method of doing it light based detection system chemiluminescence tissue fluorescence, imaging which is vel scope tissue fluorescence spectroscopy and a biomarkers DNA analysis, then laser capture microdissection.

So, lot of existing systems are there and what we have focused right, now is on image analysis technique which is your biopsy and histopathology in particular we talk about the oral brush biopsy, where we are talking about the cytopathology alright.

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So, if I want to see the system can I develop such kind of system, where we can place the system within the mouth and can reach to region which are hard to access by a mobile camera. So, you can develop this thing if you take the idea from a mouth mirror, then you can understand that this angle of 70 degree, if you go to a dentist if you have seen that there is a mouth mirror in which dentist is able to see the cavity and is different regions within the mouth right.

So, same thing we can use it for getting the images, there is a camera and 70 degree anterior portion, we have a raspberry pi to look at the images in real time we have a charging pole that you can recharge the system right. And if you see here if I see the blown up diagram and what is there is a raspberry pi injects using injection molding you can use this one a lithon battery, you have camera you have charging module boost converter and you have raspberry pi 0 to store the image as well.

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Electronic modules used in the custom-built diagnostic device for oral screening

- Captures images of hard and soft tissues inside oral cavity
- A camera with light source illuminates the area of interest
- The 70° anterior angle allows to view hard to reach oral sites
- Onboard processing unit and a display unit
- Supports storage of captured images on board
- Low cost and portable
- Can be used by a semi-skilled person such as front line health worker (Example: Accredited Social Health Activist (ASHA) worker)

Sl.No	Parameter	Value
1	Camera	2 MP and 8 – Bright white Light LED
2	Microprocessor	ARM Cortex A7 series processor
3	Display (Modular)	Supports for 3.2" Resistive Touch Screen or External display via HDMI port (not inclusive)
4	Rechargeable Battery	Lithium Ion – 3.7 V, 2700 mAh
5	Charging time of battery	1 hour
6	The discharge time of battery	35 min
7	Power Input	5 V , 1 A / micro-USB
8	Weight	350 g

Labels in diagram:
Angle of 70° (inspired from the mouth mirror) anterior portion to capture images from hard-to-reach oral sites
Electronic system with an intraoral camera with 4 bright LEDs
Removable sleeve
Button to capture images during live streaming
Power On/Off button
live video stream on 3.2" LCD display
Charging port

Custom-built Diagnostic Device

So, if I talk about further then the capture images of hard and soft tissues inside oral cavity is possible, with this a camera with light source illuminates the region of interest that is 70 degree anterior angle, there is a on mode processing unit and this is the unit and that is a advantage of this particular system over the existing systems, we will also see what are the existing system. And we will try to find out some of the videos for you. So, that you would understand the how it is done in the real life situation.

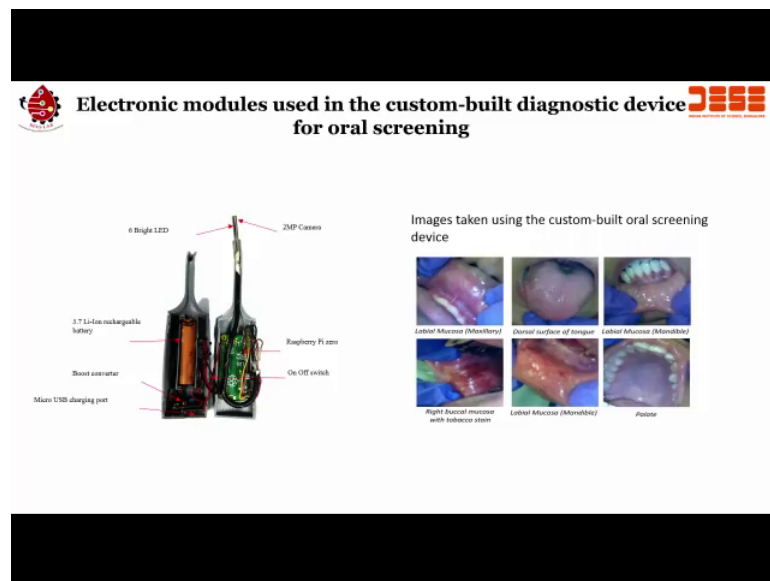
Then we have a support to store the capture images, what you will do once you capture the images you have to store the images the storing of the images is possible with this kind of tool. Of course, the cost is a very important issue and that is why the tool is costing way lower than the existing devices, it can be used by semi skilled person such as accredited social health activist which I call Asha workers right.

So, these are the advantages of developing such kind of tool over existing devices and that is why this can be used as a electronic system for screening the oral cancer patients, if you see further it that the ad the advance you put in the mouth there should be a sleeve, there you can just throw it out and you can again sleeve the next for the next patients.

So, there is a removable sleeve there is a electronic system we can intraoral camera with 4 bright led s in that in the front and like I said there is a live video screen possible, we are trying to get a wireless capability to the system and so, that it is easy to use for a remote pathologist or also no not for the remote pathologist for the Asha worker.

Also this can be also used in a in a dentistry, where you have to take the that you look at the images, you can look at the images on the this LCD display as well. So, this has the specification of parameters versus well new certain parameters like what are the camera, or what is the camera that we have used what is the microprocessor that we have used what kind of display, we are using is this is a battery chargeable dischargeable what is the charging time, how what is the discharging time, what is the power ,what is the weight of the complete system. So, this has some of the parameters you can look into that.

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Now, further you can see here this is how we have packed the devices you have a lithium ion charger battery which is right over shown here you have boost converter you have micro USB charging port, you have on off switch you have raspberry 5 0 and the bright LED s along with the ta 2 megapixel camera, but we can also use autofocus night vision camera. So, that you can get a better images.

So, this is these are the some of that we have taken from level, because from dorsal surface of tongue, I was showing it to you I was showing you the may mandibular I was showing it to you the right buccal mucosa with tobacco stain. Now, this particular thing is in so, I was not showing you this particular stain [Laughter] it is very bad actually I was showing you to you the mandibulae which is your labial mucosa, I was showing you this one and dorsal surface of tongue

This is when a patient is having a habit of eating tobacco or chewing tobacco, in that case with the right buccal mucosa with tobacco stain, you can see right over here and the pallet is also visible, but the disadvantage of the mobile I already discussed and that is why this system can be used to take images from several regions right. So, in my place when you see this particular region, you will see it is clear because I do not endorse rather I do not use tobacco for chewing and in fact, I will you advise you guys not to use any tobacco or tobacco related products, because it is really harmful even chewing the betel nuts are really harmful. So, as if you want to be healthy stay away co stay away from tobacco related items, pan masala you know cigarettes something in villages we will also find beedi right. So, please stay away from all these kind of new sense it is going to hamper your health.

And if you are talking about health care technologies first thing is we should understand that what are the things, how can we have a better precaution how can we have a healthier life and healthier life is when you are away from tobacco right. So, try to be away from tobacco, try to be away from any related products including smoking of tobacco like cigarettes, it is harmful for your lungs it will cause lot of damages to your mouth, there is a oral cancer chances are very high for people who smoke tobacco, a chew tobacco and also chew tobacco related products. So, and my sincere advice and sincere appeal to all you guys who are watching this particular program is to stay away from such kind of you know habits, and have a healthy lifestyle where you can you can eat pan, but without tobacco.

You see the that is good for health by the way, but we when we add the tobacco related products it is not good, beetle nuts too by the extent not good right. So, anyway my point is that if see the buccal mucosa in my mouth you will see that it is different than the one that you can see right over here. So, that is the difference that we can obtain if we have the image.

So, imaging is very important and to develop a system for a capturing this image is also equally important, we are talking about a system that can be used to obtain the images or capture the images. Once you capture the images the system should be able to store the images the systems will not only be able to store the images, but or able to transmit the image wirelessly, because if I take the image in my mobile I can send the images

wirelessly. So, my system should also be able to store and so, capture store and transmit the images which is wireless also.

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Comparative study of available devices with the handheld electronic module

Feature	Veloscope	Oral ID	Oscan	Custom-built module
Electronics	Has Only LEDs And optics Does not have inbuilt processor in the device	Has Only LEDs And optics Does not have inbuilt processor in the device	Has Only LEDs And optics Does not have inbuilt processor in the device	Has both LEDs and optics Has inbuilt processor in the device
Usage	Can be used as a standalone examination tool or as an attachment to the mobile if it is not interfaced with the mobile	Can be used as a standalone examination tool Neither interfaced with mobile nor can be attached to mobile	Can be used by attaching to mobile	Can be used as a standalone examination tool. It also comes with an Android app and the tool is interfaced with it
Display	Viewed directly with naked eye	Viewed directly with naked eye	Viewed directly with naked eye	Can be viewed on a big LCD / LED display
Wireless Communication	No	No	No	Yes - Communicates with Android mobile using WiFi and send images to it
Fluorescence based diagnosis	Available	Available	Available	Both white light and fluorescence based diagnosis
Cloud Connectivity	No	No	No	Yes
Camera	Uses phone's camera	No	Uses phone's camera	1.1" Digital CMOS Camera Module with integrated LEDs for illuminating mouth, camera has built in Autofocus feature so we can capture two images at different distance for processing
Operating System	No	No	No	Yes - Uses Linux OS
User Interface	Yes	Yes	Yes	Yes
Data Storage in local device and cloud	No	No	No	Yes
Potential to create a detailed oral profile of several patients.	No	No	No	Yes
Potential for AI in Artificial Intelligence (AI) and Point of Care (PoC) diagnosis	No	No	No	Yes
Price	₹ 100,000	₹ 100,000	Not in market	₹ 10,000

Let us see what are the existing system that are used for this kind of application. Now, if you see there are certain system first is Velscope, then we have a oral ID we have a Oscan and then we are talking about our system ok. So, let us see when you talk about electronics. So, electronics the velscope and oral ID as well as the oscan they all have only LED's and optics and does not have inbuilt processor.

While in our case we have a inbuilt processor right, usages this can be used velscope can be used as a standalone examination tool, or an a as an attachment to the mobile oral ID can be used as a standalone examination tool in either interface with mobile nor can be attached to mobile. While image curve one we talk about Oscan or Oscan then can be used by attaching to the mobile while in our case can be used as standalone examination tool it also comes with an android app and tool is interface already with it.

So, what does that mean if you see this particular device, this system if you see the image the system also has the inbuilt you know capability of storing the images also, we can have the app right indicator onto this particular platform that is the advantage. Now, another thing are display so, viewed directly with a naked eye view directly with naked eye in case of velscope and oral ID also in case of Oscan it is viewed directly with naked eye and can be viewed on a big LCD or led display.

This is a advantage wireless communication it is not there in all three while in our case, we have the wireless communication android mobile using Wi-Fi and can be send images to it, fluorescence based diagnosis it is available in all 3, but we have both white light and fluorescence based diagnosis. This advantage next one is to a cloud connectivity in all 3, when we are talking about the remote server will be require a cloud server in case of velscope in case of the oral ID or we in case of the Oscan, we have the cloud we do not have the cloud connectivity while in our case.

We have that finally, the camera that is used is phones camera here there is no camera and here, you use phones camera and we are using now 1 by 9 inch display CMOS camera module with integrated 12 LED's for illuminating mouth camera has inbuilt autofocus features. So, we can capture 2 images at different distance for processing, which advantage over existing module.

Then talk about operating system none of this has operating system and we are using Linux operating system, data storage in local device and cloud, it is not available in any of them, but we can do that potential to create detail oral profile of several patients we can do that and there is a potential of adding artificial intelligence, we can also do that right.

Now, as per as our literature survey goes they this about 300000 this is 300000 rupees 100000 rupee I we do not have any value for this. So, we assuming there is not in market where our cost estimation is only 30000 right. So, there is a advantage over the velscope oral ID and Oscan by (Refer Time: 15:47) talking about velscope it is about 300000 oral ID is about 100000, we do not have the value for this, but for our system it is about 3 30000 rupees that is what I talked I think we cannot see, but if you can see them that is what I meant ok.

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Device	Price
VELSCOPE@ VX SYSTEM	₹ 300,000
OraID	₹ 100,000
Custom-built handheld electronic module	₹ 30,000

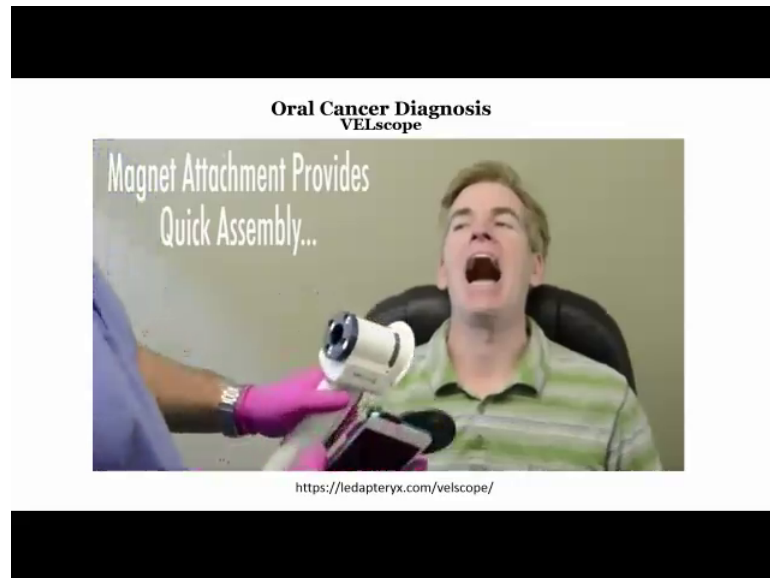
So, comparison of various oral assessment devices is right over here, this is how the velscope system is used as you can see we have to rely on the eye site of a clinician. And he has to see through the velscope, it is a fluorescence imaging you can see to understand whether person is suffering from cancer or not oral, ID as you can see here right can be used for proper seeing only certain region, but we have our own device that can be used while hard to access region you can see the images on the display itself. So, you do not have to really worry about the images the quality of image is really good.

We are using a autofocus camera, we have a bright film fluorescence imaging and all this thing you can do, with very easy things whatever you have worked on is simple things like developing the system with a cad model and fabricating it using 3 d printing or injection molding we are using a raspberry pi, which we are already using it we are using a boost converter which you have none, we are using a charging module which is available where is your lithium ion battery which is available right. So, it is not a great deal to develop a system when you know the real problem right that is thing it is very important that what are what is the problem and how can we develop a system for solving that particular problem right.

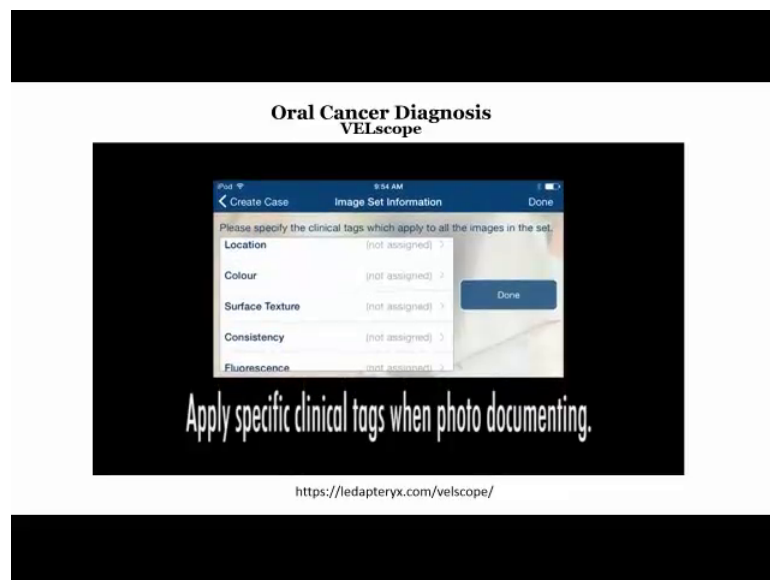
So, with this now I will end up my module here and I will try to see some of the videos, that if available can I can show it to you so, that you will know in detail how the

velscope and oral IDs are used in a real life situation right till, then you take care I will see you in the next class bye.

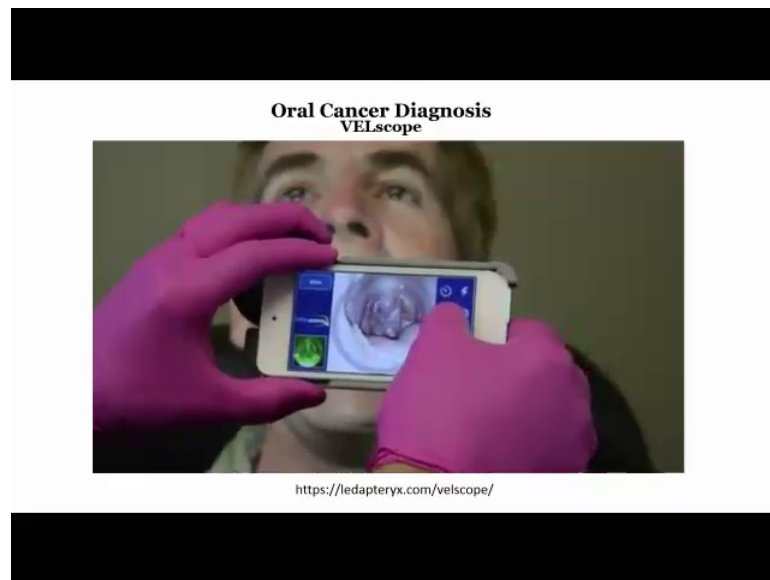
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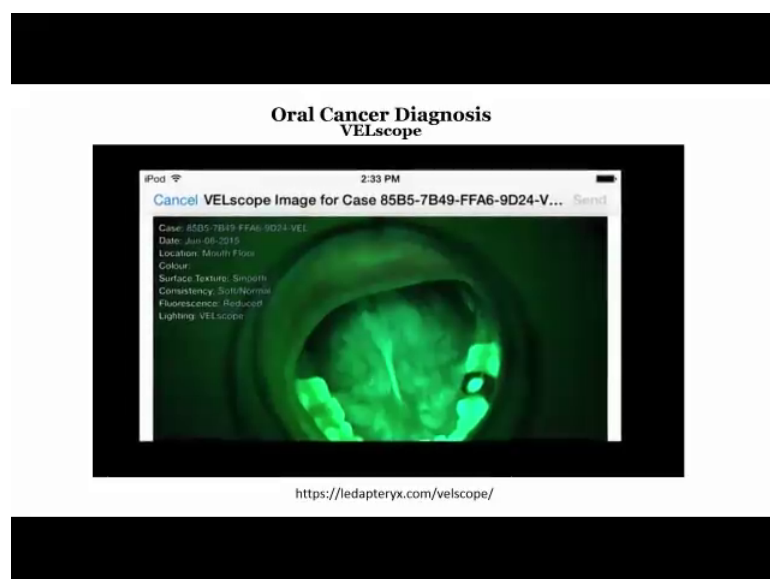
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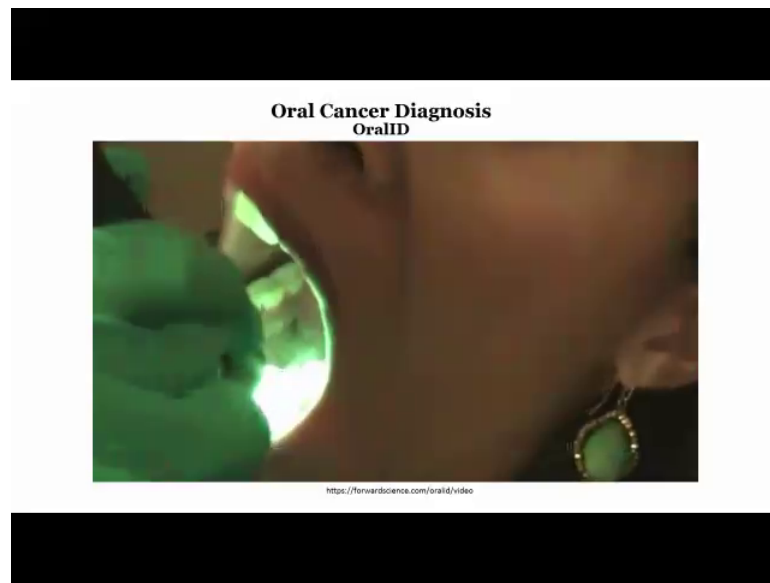
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Show surround skin look around the vestibular area and check for any lesions any dark areas, (Refer Time: 19:21), we will check the (Refer Time: 19:31) cheeks and take the tapial tongue, if I use to review now definitely check under the tongue which is usually or oral cancer curves (Refer Time: 19:47) and stick you, tongue out for me it is like graph look at you right here.

And look on the sides of the tongue the lateral borders and under the tongue are the common places for oral cancer to occur ok, I am just going to look the back of the throat back of the tongue say flemmi, why everything looks clear any dark areas (Refer Time: 20:21) yeah.