Biophotonics
Professor Basudev Lahiri
Department of Electronics and Electrical Communication Engineering
Indian Institute of Technology, Kharagpur
Lecture 45
Laser in Dentistry

Welcome back, we are discussing application of laser on biological matter for some kind of correction of different human ailments. In the previous class we saw how laser could be utilized in correcting vision, ophthalmological application and in this particular topic, in this particular lecture; I want to focus on laser in dentistry.

Here I am thankful to my friend and to my collaborator, Doctor Prabhat Kumar Chaudhary from All India Institute of Medical Science, New Delhi; he is fantastic dentist but above all, very, very good friend and again, his paper or his work or his research is something that inspires me and I try to learn from it and it was his work that has helped me in going into reading this particular topic.

Along with that, I want to acknowledge the names of Professor R.R Paul, who used to be the, I think principal of R Ahmed dental College of Calcutta. Now, presently is the professor in charge of Guru Nanak Institute of dental science in Calcutta. So, these are, well, Professor R.R Paul is quite well known, and for someone like me, who has come from a completely different background electronics engineering, to understand the ideas of dentistry, you have to acknowledge how good the teacher has to be to teach a student like me, who has zero idea on dentistry.

So, again, I am again not the right person to teach you give you dental knowledge, but I will, I will give you; I will try to give you a brief introduction of how or where some run of the mill examples of how laser can be utilized in dentistry or some kind of dental operation.

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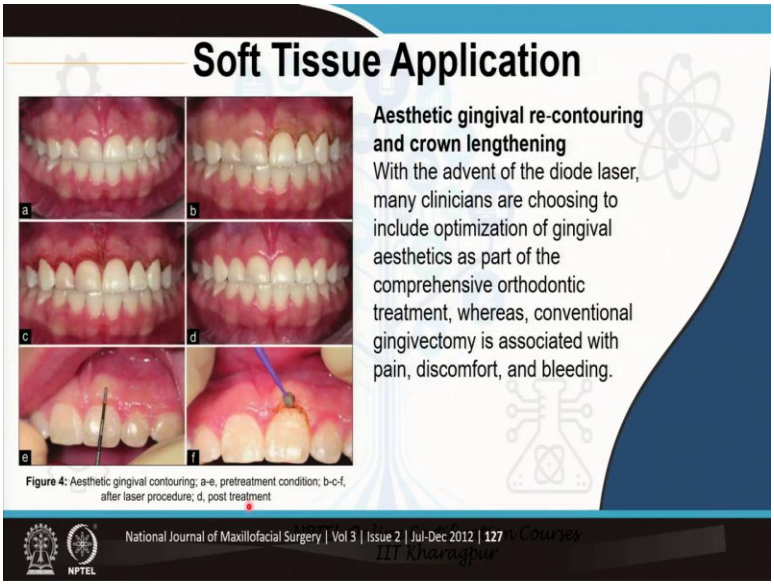

So, mostly, mostly, laser has been thus far utilized in soft tissue application. But as the day are progressing, we are applying it constantly into hard tissues as well, like teeth or enamel or the jaw bone or different areas. But in this topic, I will stick to soft tissue application because; somewhat I am comfortable with this because you understand I am going into someone else is area of specialization and which I have limited knowledge of.

So, whatever I am trying to say I am trying to say from my point of view and that might be not 100 percent accurate. Obviously, I cannot replace someone's knowledge or skill that the person has accumulated over a lifetime within a couple of lectures or a couple of slides. So, that is also not my intention, but it is my intention to give you the general idea, general idea where laser can be used when it comes to dentistry.

So, one of the common examples these days are aesthetic gingival recontouring. I told you, gingival I hope that I am pronouncing it right is gums, gums where teeth are connected and when you want to recontour it you have some kind of a, you want to reshape your gum, you want to reshape your gum because for aesthetic purposes or crown lengthening you want to lengthen the crown, laser is being constantly used. This is very common tool in the hands of dentists by which they recontour or restructure your gums.

So, this is gingival or this is what we call as gum. So, a to e you can see pretreatment condition, a, c, e are this pretreatment condition and b, c, f are the laser treatment and d is basically what

this was before and this is after, this was before and this is after. The gum has been re-contoured using laser and their idea is conventional gingivectomy is associated with pain, discomfort and bleeding.

You put something, some kind of a micromechanical tool, some scalpel, some scissors, et cetera to re-contour your gum and the idea is using diode laser, run of the mill laser. You can actually reconstruct it and thereby painlessly rectified, though, I am skeptical on the term painless because I am terrified of dentists, both literally and figuratively.

All other pain can be somehow mitigated, but dental pain, tooth ache is something that I fear too much and when they say that there would not be any pain, I am as skeptical as I was as a child, when my mother used to take me to the doctor and the doctor would give me an injection and the doctor will always say it is like an ant bite. It is not like ant bite hurts like hell to me. So, when they say there is no pain, well, I am not going to, I am not going to spend too much time thinking about it. So, you can use laser light to reshape your gums.

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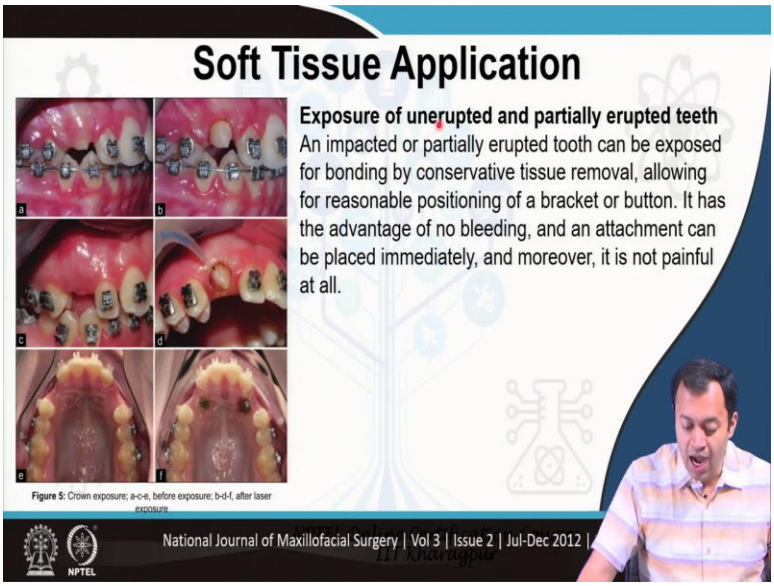

Also, if you have unerupted or partially erupted teeth, some teeth which are not yet, they use the term eruption, which has not yet come out. So, teeth which is still inside the gum, even though you are quite old, so some part of the teeth has is situating here inside the gum and has not yet come back, you can ablate this tissue area using laser and expose it and then using some kind of a hook bring it back.

So, it can be exposed by for bonding by conservative this, this process this, this hooks, this clamps are called bonding I know, I know, my dentistry students are having the time of their life finding me trying to explain their area of expertise So, hi to them and maybe one day you will we will meet and you will make fun of me to my face, but from now on laugh from your computer screen.

So, the area here is that this area is exposed and again the advantage is no bleeding and an attachment can be placed immediately it is not painful at all. So, they say, so they say not me refer to this paper, refer to Prabhat Chaudry of AIIMS not painful at all I am, I will not be hold responsible if you feel pain, if I feel pain.

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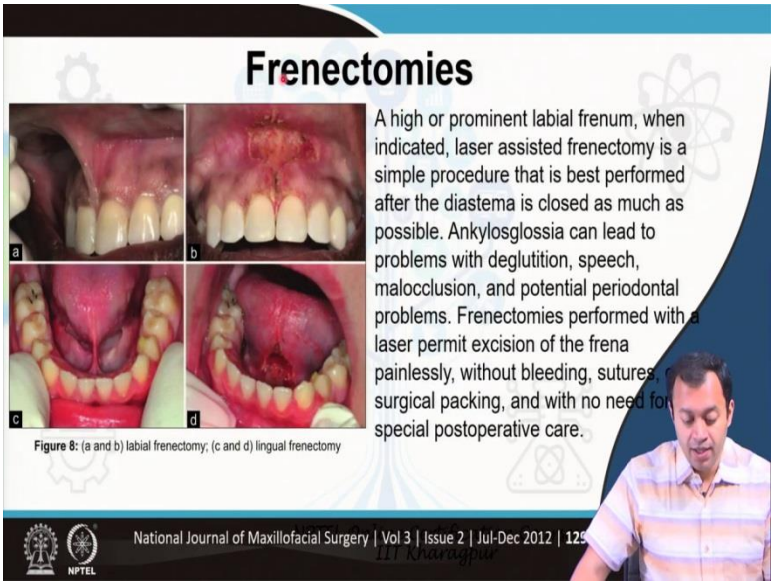

This is something which quite interests me, Frenectomies. So frenum, is this is this soft, lining of tissue that connects our mouth with the gum. So, we have that in our tongue. The tongue is connected with the lower palate with this, with this particular frenum this tissue and the top or the top layer of our, of our lips is also connected through the gum using this soft tissue and this, Ankyloglossia which basically means tongue tie, where you have a very thick tissue.

So, this lining in some people, this soft tissue that connects the upper portion of your, of your lips and the lower portion of your lips to the mouth is very thick and thereby the movement of the tongue and the movement of the mouth is also restricted and that causes several different types of problems. So, they come up with beautiful, beautiful languages, deglutition which

basically means swallowing, they have problems swallowing, inject in, ingesting food, speech, malocclusion and potential periodontal problem.

I forgot what he told me, but I forgot what malocclusion actually means. So, you can look it up and potential periodontal problems I do not know but basically you understand if your tongue movement, if your tongue has difficulty moving then obviously you will have difficulty anything that is associated with tongue basically speech, you will have difficulty speaking you will have difficulty swallowing. I think malocclusion is something like arrangement of teeth.

The teeth are not arranged properly, they are like in a different direction, or some sort of which, which are malocclusion I think, no, I remember periodontal problem is wrong arrangement of teeth and malocclusion is probably something that allows plaque formation in your mouth due to not brushing or not flossing.

So, several types of problems are associated with it, I hope my, my teachers are proud of me now, for teaching them they suffer for telling you this, but you need to know. So, frenum is this part and frenectomy is performed with laser permit, painlessly without, without bleeding. So, you burn this area up so that you burn this area come on this has to be painful, I do not know you, you just break this tissue up and your tongue can then move and with no need for special post-operative care, supposedly, you do not need any more post-operative care no bandage or nothing is actually required.

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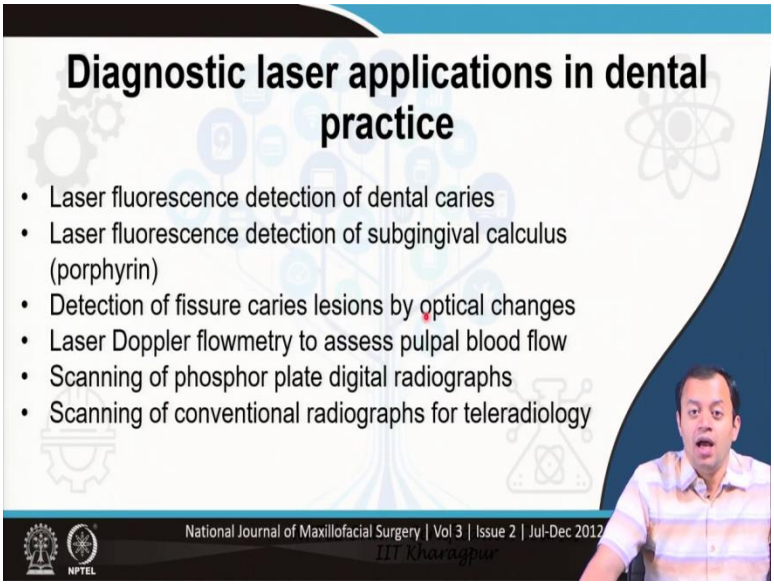

So, where do you go for applications of laser in dental practice? These are some, some applications which every, most of the dentists are doing using laser; this is quite interesting for me, laser Doppler flowmetry to assess pulpal blood flow. You remember, we discussed about this we can go for a Doppler flowmetry to see if there is a clot in your blood vessels. So, it is very similar to that, you need to know where your blood flow in, in different regions of your, of your face head or neck or mouth.

And of course, fissures or cavities or lesions by optical changes you if there are some kind of a micro cavity not everything has to be bigger. So that you will see if there are some kind of micro cavity early stage, you can see the light is getting deflected or diffracted differently and that could also be done. And of course, laser fluorescence detection for dental caries, all of those things are very common these days in any standardized dental practice. So, they use these lasers anyway.

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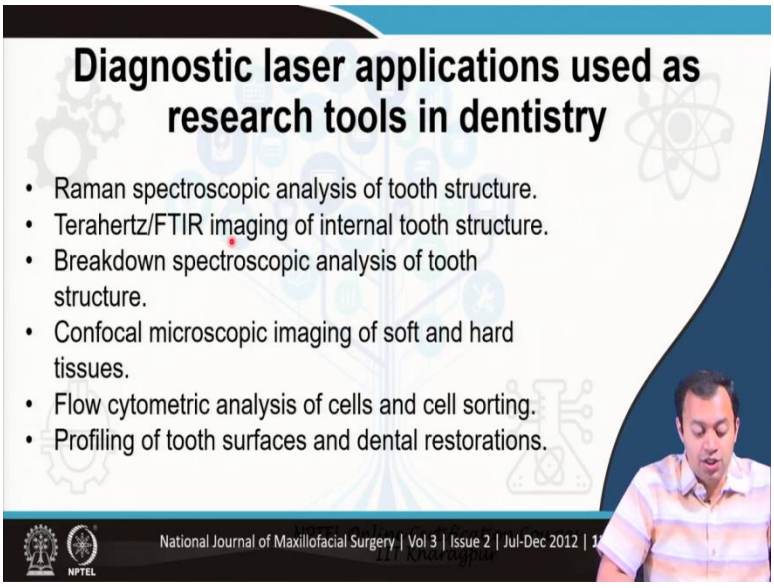

What is the future, what is the future? This is where we are collaborating; I am collaborating with, with the dentist set at, at various dental colleges. These are the FTIR imaging of tooth structure. So, if we can image non-destructively a tooth and thereby come to some kind of an explanation that if the tooth is healthy internally, there is a problem something is required. I am also looking at dental tissues, oral tissues, oral cavity tissues, doing some kind of an FTIR or Raman spectroscopic imaging, images of them.

We are publishing paper in this regard. I myself am personally involved. So dental tissue has been taken out from mouth ulcer or if there is some kind of lesion or some kind of a tumor forming inside the mouth and thereby trying to go for early detection of oral cancers. Remember oral cancer is Indian cancer. I am here quoting completely Professor Paul from Guru Nanak Institute. Indian, oral cancer is Indian cancer people mostly suffer in India, or oral cancer is mostly suffered by the Indian subcontinent, patients from the Indian subcontinent.

You rarely would find this, this cancer happening somewhere else because of the lifestyle choice of eating pan masala and tobacco, chewing tobacco you do not, mostly do not smoke we chew. So FTIR based imaging and Raman spectroscopy can be used for earlier detection of oral cancer and thereby you come to some kind of a practice so that a person can be immediately detected that the cancer has set in and thereby take some treatment. Confocal microscopy by this time you know what confocal microscopy is soft and hard tissues. Flow cytometric analysis and profiling of dental surfaces.

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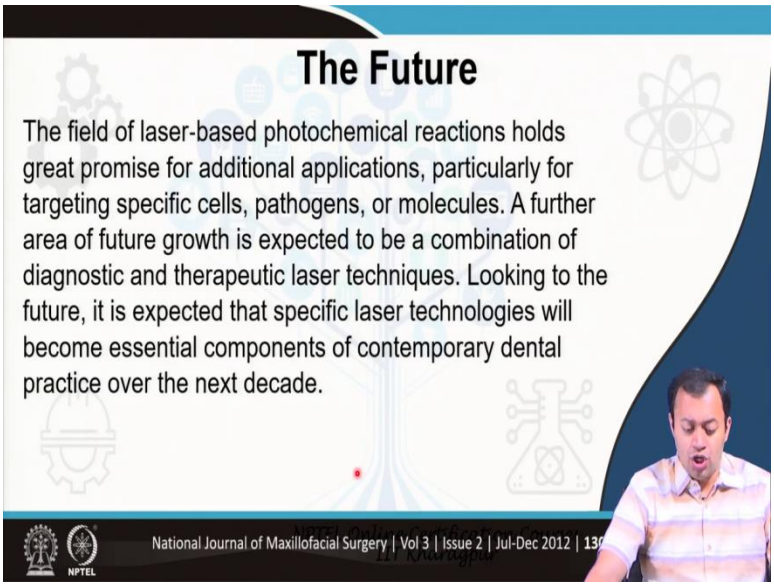

So, what are the future? So, the future is again several important things; a further area of growth is a combination of diagnostic and therapeutic laser techniques. Remember, this is what I am talking about optical biopsy and here you are sending different types of laser through different types of molecular from, from optical fiber that are connected in the same bunch.

So, one laser is sending light and other is receiving it, another may be doing some kind of an ablation, so that you can both see in real time some kind of therapeutic intervention is happening. So, something inside microscopically there is some kind of an oral problem, say for example, a cancerous growth has come up, you both want to see it, image it, at the same time send lasers maybe PDT therapy or something like that to destroy that tumor and you are seeing it in real time. So, specific laser technology will become contemporary practice over the next few decades.

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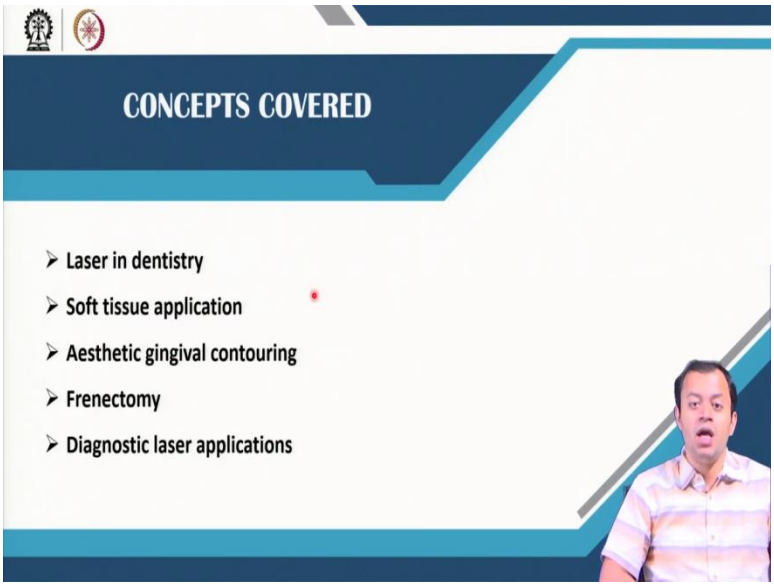

So, these are the two very, very run of the mill applications that I gave you off laser in direct surgery, I gave it on cosmetic surgery, cosmetic application, aesthetic applications, dermatology, skin, that is eye and then dental. Obviously, these are not the only one, I have not even touched heart, lung or neurosurgery and it can go on, it can take on forever. Laser as I said, nowadays is everywhere. You cannot if even, if you try you cannot escape laser.

So, obviously whatsoever I told you about the eye surgery or from a dermatology skin perspective or dentistry perspective, none of them were from a specialist point of view. Let us, let us be absolutely clear, I cannot repeat it enough I am not a skin specialist or an eye specialist or a dentist, but this is a general idea.

Consider me as a Wikipedia giving you information on these topics. So, if you want specialized information, you have to seek specialized help. On the other hand, if you are a specialist

yourself, if you are an eye doctor or a skin specialist or a dentist, then I would welcome your inputs and try to tell me where I have gone wrong if I have gone wrong and how to improve this so that anyone who is not from these backgrounds, from physics or electronics like me, they can benefit from what you do.

On the very first day you cannot expect us to become an expert in ophthalmology, just like I cannot expect you to become an expert in quantum mechanics. So, it goes both ways. So, thank you very much for your attention.

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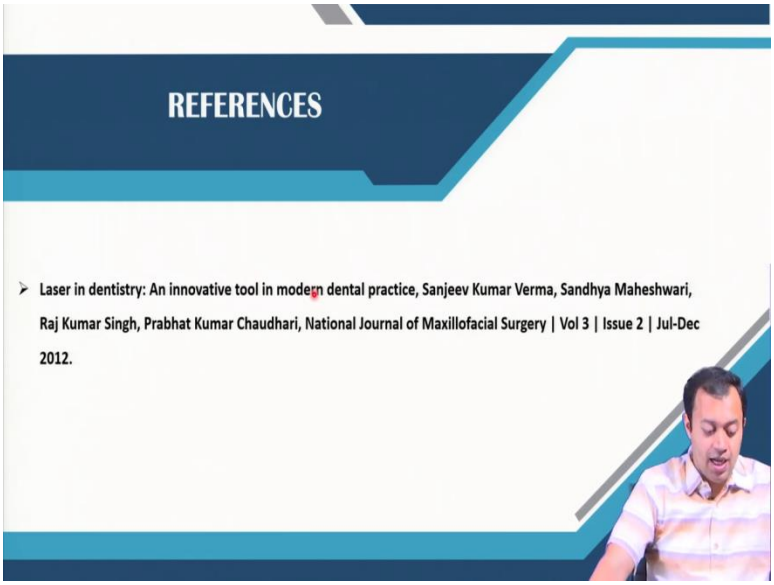

These are, this is the paper that I refer to of my friend Prabhat again, I thank him very much for letting me use his research work, those pictures are obviously not taken by me, by taken by these fine gentlemen, these fine researchers and thank you. Thank you very much