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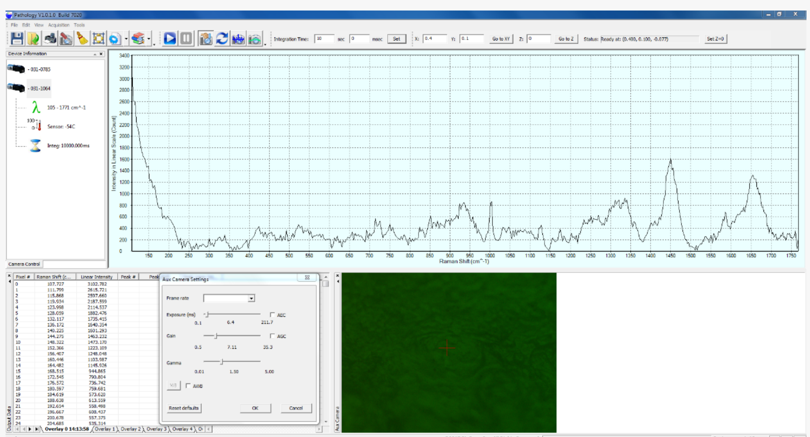
A rapid evaluation technology for cancer lesions in gastrointestinal tract raw tissue using Raman spectroscopy

A research group led by Showa University has developed a rapid evaluation technology for gastrointestinal tract cancer raw tissue using Raman spectroscopy.

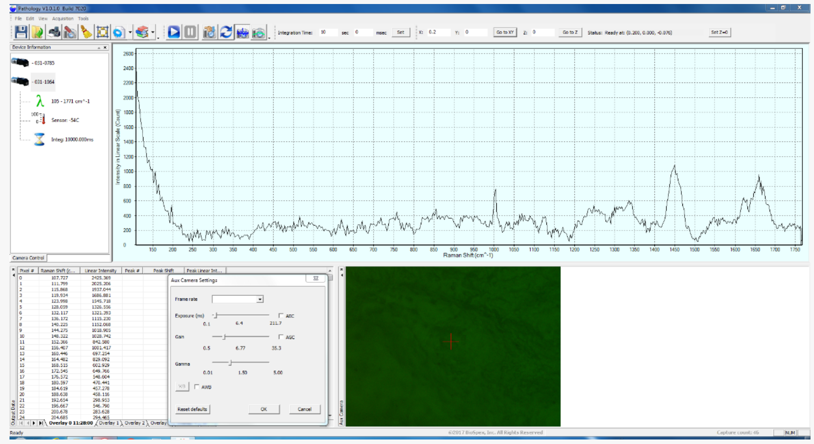
Proprietary Raman microscope designed for biological sample analysis.


Raman spectrum of Esophageal cancer.

TOKYO, JAPAN, June 29, 2023 /EINPresswire.com/ -- Showa University (Shinagawa Ward, Tokyo / President: Tadashi Hisamitsu) Associate Professor Hiroaki Ito (Advanced Cancer Research Institute) and other research groups (JSR Corporation, BaySpec Inc., Fuji Technical Research Inc., Saitama Cancer Center) has developed a technology for rapid evaluation of cancerous lesions in raw tissues of the esophagus and stomach by applying Raman spectroscopy. This technology is expected to become an important basic technology for realizing real-time diagnosis of living organisms in endoscopy and surgery. The results of this research were published in the online version of the international academic journal "World Journal of Gastroenterology (https://www.wjgnet.com/1007-9327/full/v29/i20/3145.htm)" on May 28, 2023 (US Eastern Standard Time).

Research Background
Appropriate treatment based on accurate diagnosis improves cancer treatment results.

Gastrointestinal cancers such as esophagus, stomach, and colon cancer are diagnosed by endoscopy. In order to confirm the diagnosis, it is necessary to collect a tissue (tissue biopsy) and perform a histopathological diagnosis. It takes about 1 to 2 weeks from endoscopy to confirm the diagnosis. After a definitive diagnosis is obtained, the most appropriate treatment method is selected based on a comprehensive diagnosis including non-endoscopic examinations such as computed tomography. When endoscopic or surgical treatment is actually performed, the doctor will perform appropriate treatment while adding clinical judgment. Then, the appropriateness of the treatment is evaluated by performing histopathological diagnosis again on the resected tissue. Depending on the degree of cure, additional treatment such as reoperation may be required. In this way, in cancer treatment, it takes a certain amount of time from medical examinations to confirming the diagnosis, and from treatment to confirming the degree of cure.



Raman spectrum of Gastric cancer.

When endoscopic or surgical treatment is actually performed, the doctor will perform appropriate treatment while adding clinical judgment. Then, the appropriateness of the treatment is evaluated by performing histopathological diagnosis again on the resected tissue. Depending on the degree of cure, additional treatment such as reoperation may be required. In this way, in cancer treatment, it takes a certain amount of time from testing to confirming the diagnosis, and from treatment to confirming the degree of cure.

We wanted to shorten the time from examination to definitive diagnosis by applying advanced technology to medicine and incorporating qualitative evaluation into morphological evaluation. In addition, we thought that it would be possible to more accurately understand the condition of cancer during treatment and provide optimal treatment that is neither too much nor too little.

Purpose and method of this research

As mentioned above, our main goal is to quickly and accurately understand the state of cancer in the gastrointestinal tract, and to realize appropriate treatment according to the condition of cancer. We chose Raman spectroscopy as one of the techniques for this purpose. Raman spectroscopy is a technique that utilizes the phenomenon that the light reflected from a substance contains light with a slightly shifted wavelength (Raman scattered light) in addition to the irradiated light. By examining the waveform of the Raman scattered light in detail, it is possible to estimate the components and molecular structure contained in the substance to be evaluated (any state, such as solid, liquid, or gas; no special pretreatment is required). Due to these advantages, Raman spectroscopy has been used as a non-destructive inspection method, but it has disadvantages such as being greatly affected by autofluorescence, making it difficult to apply it to living organisms.

In this study, we used a unique micro-Raman apparatus designed to be less susceptible to autofluorescence and not to damage living tissue. Esophageal tissue (esophageal squamous cell carcinoma 6 lesions) and gastric tissue (gastric adenocarcinoma 10 lesions, gastric adenoma 1 lesion, gastric mesenchymal tumor 1 lesion removed by endoscopic treatment) were used as samples, and Raman spectra (*5) were recorded immediately after excision. After that, the tissue was fixed with formalin as usual and histopathological diagnosis was performed.

Research results
We were able to record Raman spectra from all 18 tissues. There were no thermal injuries in any of the 18 tissues, and histopathological examination could be performed without any problems. We were able to identify the extent of cancer with almost the same accuracy as histopathological examination by using an appropriate algorithm set for specific parts of the Raman spectral patterns of the esophagus and stomach.

Future outlook
In this research, we were able to demonstrate the possibility of quickly and accurately ascertaining the state of cancer in raw tissue that has just been removed from the human body. This result indicates that it may be possible to evaluate cancer in the human body. By adjusting the focus of the near-infrared laser used for measurement, it is possible to evaluate not only the surface but also the deep part. And most importantly, because of its extremely low biotoxicity, this laser has already been applied medically and used in the human body in fields other than cancer. The part that irradiates the laser and detects the Raman spectrum can be made into a shape that passes through the forceps hole of the endoscope using an optical fiber, so theoretically it can be applied to the human body immediately. This technology is considered to be one of the important technical elements for realizing a "one-stop operation for cancer" that performs "real-time diagnosis" during examination and, if possible, carries out appropriate treatment at the same time. In the future, we will expand the scope of evaluation to organs other than the esophagus and stomach, promote research while confirming the analysis accuracy and the presence or absence of biotoxicity, and aim to complete real-time diagnostic technology for living organisms.

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