Gastric and Colon Cancer Imaging with Swept Source Optical Coherence Tomography

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Abstract—**Swept source Optical coherence tomography (SS-OCT) is used to image the cancer samples of 12 gastric and colon cancer patients, including 5 gastric cancer and 7 colon cancer patients. The OCT images and histopathology sections show obvious difference between the normal tissue and cancer tissue. The regular layered structure can be seen at OCT images of normal tissue, while the disordered textures and destroyed layers' architectures preserve as the common features of cancer tissues' images. The variation of texture matched between the OCT images and ordinal pathological sections**

Keywords- Swept sourceo ptical coherence tomography, gastric cancer,colon cancer, surgery guide,

I. INTRODUCTION

Optical coherence tomography (OCT) is a developing image technology in recent decades. Optical coherence tomography is considered to be a promising medical imaging technique, because it permits the imaging of tissue yielding micron-scale resolution images, real-time. Another advantage is OCT can gain the images of tissue with resolutions approaching that of biopsy and histopathology, without moving tissue specimens or apply additional contrast agents on the tissue. Fujimoto, Yun, Hube et al developed several kinds of OCT with faster speed and higher resolutions [1,2,3,4,5], and the SS-OCT is the technologically advanced. SS-OCT uses a wavelength swept source with 100-nm bandwidth can arrive ultrahigh axial resolution, which is about 10 times higher than that of ultrasound images. Compared to spectrum domain OCT (SD-OCT), SS-OCT appears faster image speed, higher sensitivity. The infrared light of 1.3μm shows stronger penetration on the human tissue, which means the more image depth.

There are a lot of researches about applying OCT on human tissue, for example, skin[6,7,8], oral[9,10], cervix[11] . Endoscopic OCT imaging of human gastrointestinal (GI) tract has been demonstrated by a few groups, while it is still challenged to investigate stomach and colon with OCT. because, stomach is located on the deep of GI tract so the probe is difficult to reach or brings unthinkable suffering to volunteers. The laparoscopic surgery allows the OCT probe getting through the trocar into stomach and the surgical instruments can be used to flatten stomach tissue improving OCT imaging quality. OCT technique provides real time, high-resolution, subsurface imaging, showing the cancer locations and range to guide doctors, which is significant value to stomach cancer surgery.

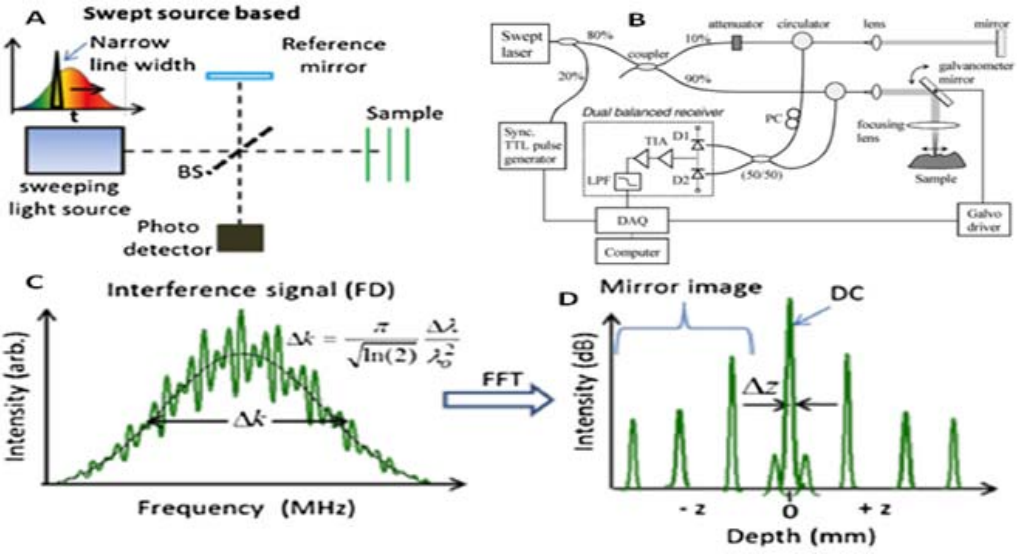

Fig 1 A: The schematic diagram of SS-OCT (BS: Beam Splitters), B: The structure schematic diagram of OCT system, C and D: the processing of interference signals transform to imaging signals.

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II. METHOD AND MATERIAL

Figure 1 shows the schematic diagram and structure diagram of SS-OCT system. The wavelength scanning of light swept source is from 1260 nm to1360 nm, and the repeat rate is 100 kHz. Every wavelength scanning cycle is an A-scan, which images to a point position in depth. One B-scan, comprised by 512 A-scan in line, can image to a section, which appeared a 2-D tomography image in depth direction of one scanning line.

The optical system is composed by a Michelson interferometer, and the interference signals produces from the reflected optical signals from the reference arm and sample arm, and detected by a balance detector. Depth profile (A-line) is converted into linear k-space and then performing fast Fourier transform (FFT) algorithm on it.

III. RESULTS AND DISCUSSIONS

The OCT images of normal tissue show the distinct layer structure of mucosa layer, submucosa layer and muscularis propria layer. Mucosa appeares a strong backscattering ability, which leads to a high light feature in OCT images and also decreases the light power intensely. Submucosa is a kind of sparse tissue, and the low scatter feature is similar with adipose tissue in optical characteristic, which appeared a low light backscattering. The dividing line of mucosa and submucosa present clearly in OCT images.

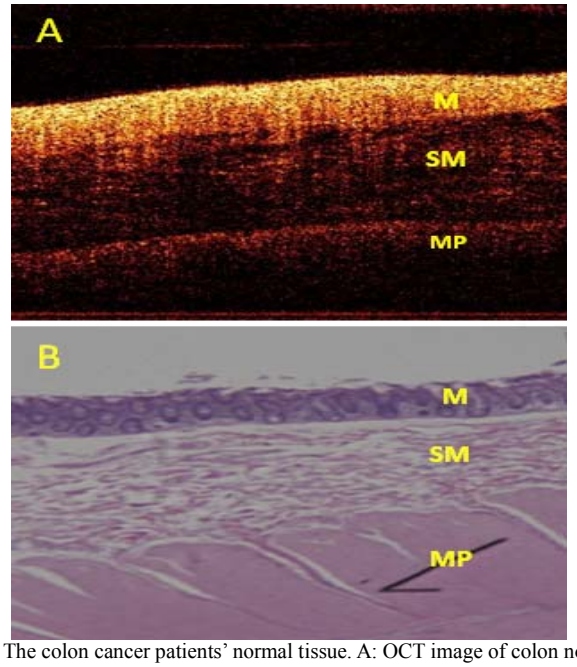

Fig.2 The colon cancer patients' normal tissue. A: OCT image of colon normal tissue. B: corresponding histopathology section to A. M=mucosa; SM=submucosa; MP= muscularis propria;

The mucosa and submucosa are disordered by mucus in pathological sections, and the mucus even permeates through the surface. The OCT images are characterized by total irregular layered architecture of the stomach and colon cancer tissue. Generally, the OCT pattern of stomach and colon cancer wall is heterogeneous. Regions of high backscattering alternating to poorly backscattering crypts are visible in tomographic images; where the poorly scattering areas are produced by mucus while the high light region corresponding to mucosa. These arrows in Fig.3 show the corresponding location between the pathological sections and OCT images.

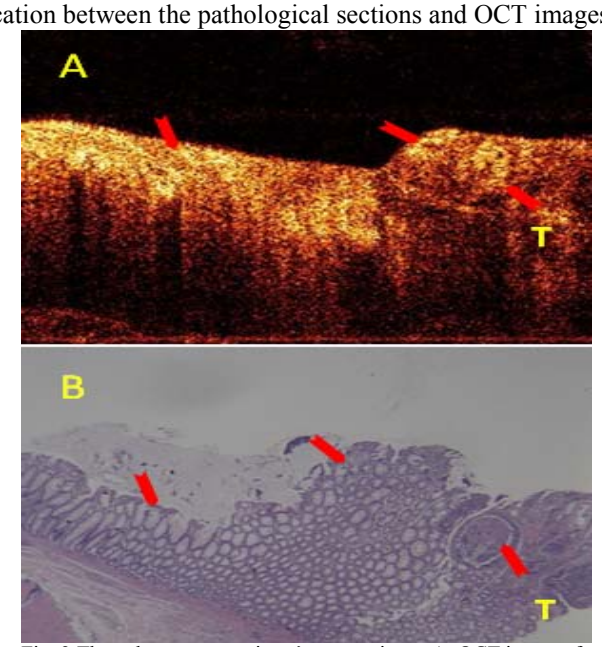

Fig. 2 The colon cancer patients' tumour tissue. A: OCT image of colon tumour tissue. B: corresponding histopathology section to A.

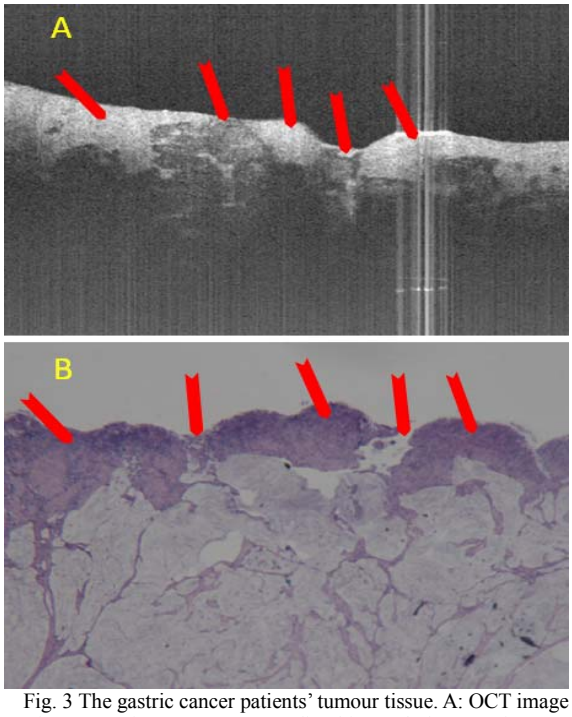

Fig. 3 The gastric cancer patients' tumour tissue. A: OCT image of gastric tumour tissue. B: corresponding histopathology section to A.

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IV. CONCLUSION

We demonstrate a SS-OCT system to image for clinical sample with gastric and colon cancer patients. The large number of OCT images showed the feasibility of imaging the cancer tissue with OCT technology. We try to apply OCT technique to guide surgery of excision of stomach and colon cancer tissue. A real time OCT image intraoperative feedback could help doctors making decision.

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