QUANTITATIVE MEASUREMENT FOR PATHOLOGICAL MICROSCOPIC IMAGE OF A1 PULLEY BY DIGITAL IMAGE PROCESS

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INTRODUCTION
Trigger finger is one of the most common hand diseases. It is diagnosed at the location of A1 pulley where the narrowed canal or enlarged tendon restricts the normal tendon gliding with symptoms of pain, disability, snapping, or even lock in flexion occasionally [1,2]. The dense connective tissue is composed of compact and parallel collagenous fibers with eosinophilic pink in color by hemotoxylin and eosin stain (H&E) stain, and rows of modified fibroblasts with long rod-like nuclei were observed in normal pulley tissue. However, chondroid metaplasia was demonstrated in the pathological pulley of trigger finger. This specimen showed round nuclei and increase of extracellular chondroid matrix. Because of large numbers of sulfate groups and proteoglycans were stained, it appeared basophilic blue or purple in color [3]. In this study, we developed a novel digital image process (DIP) system for automatic microscopic evaluation.

MATERIALS & METHODS
All microscopic images of trigger finger were provided by National Cheng Kung University Hospital and Ton-Yen General Hospital. Following marked the lesion area by pathologist, 49 images with the size of 2560x1920 were acquired by an auto-focusing system [5]. Afterwards, the pathologist selected 10 suitable images for further analysis, and ignored the rest images which were with high proportion of background or microvascular. The prepared slides were observed and graded according to the severity of myxoid change and chondroid metaplasia by pathologist. In addition, these specimens were also automatic analyzed by this system based on the above-mentioned color and shape features. This DIP system contains four parts, which are color normalization, color segmentation, nuclei classification, and parameters computed of the ratios of abnormal areas and nuclei are for disease evaluation [6].

RESULTS
The normal area values represent the sum of pink areas in 10 images (of 1 slide), and the abnormal area values refer to the sum of blue areas. The ratio of abnormal area to total area shows good correspondence with the pathologic severity which is graded to three levels as low, medium, high by pathologist. The area ratios of these three stages are significantly different. The ratio of abnormal nuclei also shows similar results. For size of 2560x1920 pixels image, the average computational operation time of color normalization, color segmentation and nuclei classification were about 5, 12 and 10 seconds, respectively. The quantitative measurement of these two parameters could be achieved automatically and precisely by this system.

DISCUSSION & CONCLUSIONS
In this study, we used DIP technology to develop an automatic system to segment the microscopic image of trigger finger. Through color adjusting algorithm to normalize color distribution, followed using a three-stepped color segmentation process to extract diseased area and applying an active double thresholding scheme to segment the nuclei, the ratio of abnormal area and the ratio of abnormal nuclei were calculated and would become two reliable indices for evaluation the severity of trigger finger. We will use this method extensively for clinical validation and explore its applicability in future.

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REFERENCES