

Chapter 24

Development of Ultrasound Imaging CAD Tool for Assessment of Pathologies in Supraspinatus Tendon

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ABSTRACT

Non-invasive diagnostic imaging methods for diagnosis of pathological conditions is increasingly gaining popularity resulting from speedy and effective recovery during follow up in several clinical trials. The accuracy of the diagnosis depends on the experience and knowledge of physicians conducting the trial. In such scenario, the need for quantitative measures for details such as shape and size of tissue can assist physicians for better intuitive understanding of tissue and its pathologies. Computer aided diagnosis (CAD) tool incorporating methods for segmentation, texture analysis and area computation can increase the accuracy of diagnosis by providing quantitative analysis of the image. This chapter briefly describes issues and challenges for building the CAD tool followed by brief description about the methods involved. The methods are validation are also discussed briefly. To summarize the work, brief discussion about a new software or CAD tool for diagnosis of pathologies supraspinatus tendon with the help of ultrasound images is provided. The new software has an intuitive user interface which is easy, quick and suitable for medical work.

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INTRODUCTION

In recent times, non-invasive medical imaging modalities such as ultrasound, magnetic resonance imaging (MRI), computed tomography (CT), X-ray are increasingly helpful for the preliminary diagnosis of the patients. The modalities assist medical practitioners by non-invasively providing the details of anatomical parts suffering from pathological conditions. The visual analysis of the tissue under examination gives qualitative understanding on the pathological state of tissue based on experience and expertise. However, since the visual analysis gives the qualitative assessment, the quantitative details regarding the shape, size of the tissues and pathological condition can provide better and intuitive understanding during follow up for physicians to better diagnose and treat the patients. Computer aided diagnosis (CAD) tools are becoming useful and effective for assistive diagnosis since last decade. The quantitative details helpful for physicians can be thickness, area of the tissue or the type and area of pathological condition within the tissue. The CAD tool incorporating the methods for assessment and measurements of pathological conditions in tissue structure can be developed using advanced imaging concepts.

Non-invasive imaging modalities such as X-ray, CT/PET, MRI and ultrasound offers several advantages and disadvantages. X-ray, CT/PET uses ionizing radiations which is harmful for human body, at the same time also provides very good contrast images for diagnosis. In MRI, the contrast of the images is very good and modality does not use ionizing radiations but MRI is not recommended for the patients with pacemakers, certain implants and intraocular metallic foreign bodies. Other challenge with MRI is its use with patients suffering from claustrophobia. Ultrasound imaging modality poses several benefits such as it is safe, as it uses non-ionizing sound pulses for scanning; it provides real time image or continuous frames for examination; it is compact and portable making it available for easy transportation; it is highly economical compared to other modalities and also the patients acceptability for ultrasound equipment is higher. Despite several advantages, ultrasound images has major drawback of low contrast and resolution which makes the modality highly operator dependent and also the diagnosis results are not easily reproducible.

Due to its benefits and capability to image the pathological condition in real time with motion it is being rigorously used for MSK applications. The ultrasound imaging allows physicians to have the real time and more flexible view of pathological tissues under examination. This chapter provides understanding about the development of CAD tool for Supraspinatus tendon. The possible reasons for development of pathological condition in the muscle are tendon rupture or inactivity. The types of tendon pathologies are:

1. Tendinosis;
2. Tear.

Tendinosis occurs due to overuse of the shoulder. In athletes participating in sports involving repetitive arm motion, such as swimming, throwing, racquet, whereas, in non-athletes it occurs due to the probable existing history of heavy weight lifting or sudden pull. Continuous or permanent rubbing also tends to weaken tendon. Tear is when tendon is no longer fully attached to the humerus, in young generation it occurs due to fall or accident, whereas for adults tear occurs due to redundant overhead movement.

CAD tool can be incorporated in diagnosis for assisting medical practitioners in two different ways. First method involves modification of existing equipment with request to original equipment manufacturer. Second method involves providing a standalone tool for assessment of tissues which should be installed along with imaging equipment. However, it should be considered that research on CAD is done not to

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