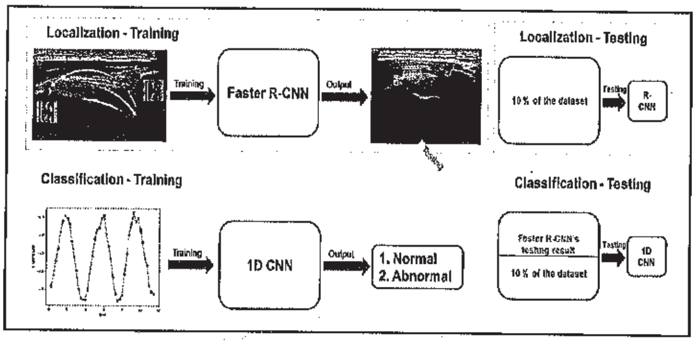
附件四、技術說明表

人工智慧驅動之動態超音波於肩峰下夾擠症候群之診斷應用



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https://www.iam.ntu.edu.tw/zh/component/content/article?id=1303:che-yu-lin&Itemid=819

市場及需求:

骨骼肌肉系統超音波，是目前用於診斷肌骨疼痛與運動傷害的第一線影像工具。過往應用此工具作診斷時，偏向利用其靜態下構造的回音度分布狀況，來做主觀性的判定。本專利技術，首先擷取動態超音波，利用人工智慧技術定位肩峰與大結節，並且使用深層學習技術，判別其為肩峰下夾擠症候群的風險，市場則可針對有處理肌骨疼痛的臨床科別(如復健科)。由於肩痛盛行率僅次於腰痛，為第二名，加上目前處理疼痛的物理治療所與診所因應老人化的社會急速開展，本團隊發展的技術搭配自費的注射與物理治療處置，極具加值性。

技術摘要(含成果):

我們自行開發的演算法，其中最高的定位性能，將被選擇用於標註肩峰下運動軌跡。前瞻模型顯示出可接受的準確性，並已刊登在 2023 年的 Ultrasonics 期刊中（Deep learning algorithm for predicting subacromial motion trajectory: Dynamic shoulder ultrasound analysis）。目前有兩種主要模型，可應用於診斷肩峰下夾擠症候群。第一種方法涉及追蹤大結節相對於肩峰的運動，並生成一個時間-位置曲線。隨後利用深度學習演算法，以分類時間-位置曲線是否對應於有或無肩峰下夾擠的受試者。第二種方法涉及向模型提供影片中擷取得個別圖像，每個圖像標記為肩峰下夾擠（+）或肩峰下夾擠（-）。數據處理將在個別影像水平上進行。換句話說，如果來自同一個個體的大多數圖像被分類為肩峰下夾擠（+），則該個體的整批圖像將被標記為肩峰下夾層（+）。我們的演算法，將基於這兩個模型的數據提供最高的肩峰下夾擠風險評估。

優勢:

肩關節的動態超音波影像，以往由於無量化評估，臨床價值有限。我們團隊是第一個使用影像擷取合併數學演算技術，將肩峰下肱骨大結節的動態影像，量化並獨家提出垂直肩峰肱骨垂直距、迴旋半徑與迴旋角度等參數。而使用深層學習技術，將所需參數迅速提取，並不需操作者人工點選，另外參數提取後馬上由人工智慧演算法，判斷是否有肩峰下夾擠的風險，此提供醫師介入前後的參考，並即時反饋給患者，此為現今醫學界尚無的前瞻肩痛診治流程。

競爭產品:

無

專利現況:

本研究團隊於骨骼肌肉超音波影像的相關應用，經驗豐富，目前於 2020 起，已經有九篇論文(https://pubmed.ncbi.nlm.nih.gov/?term=chang+kv+Lin+CY&sort=datePubMed)在 PubMed 可以被搜尋到。

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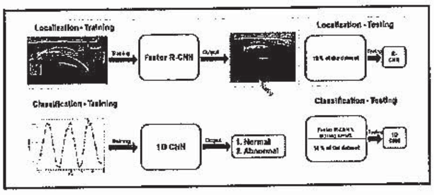
Artificial Intelligence Powered Dynamic Ultrasonography



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Experience:

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Market Needs:

The musculoskeletal ultrasound system is currently the frontline imaging tool used for diagnosing musculoskeletal pain and sports injuries. In the past, when utilizing this tool for diagnosis, the emphasis was on subjective judgments based on the distribution of echoes in its static structural conditions. This patented technology, however, first captures dynamic ultrasound images, utilizes artificial intelligence to locate the acromion and greater tubercle, and employs deep learning techniques to assess the risk of subacromial impingement syndrome. The market for this technology can be targeted towards clinical departments that deal with the treatment of musculoskeletal pain, such as rehabilitation medicine. Given that shoulder pain is the second most prevalent after lower back pain and considering the rapid expansion of physical therapy and clinics addressing the aging society, the technology developed by our team, combined with self-paid injections and physical therapy interventions, offers significant added value.

Our Technology:

Our self-developed algorithm, demonstrating the highest localization performance, will be chosen to annotate the subacromial motion trajectory. The preliminary model has shown acceptable accuracy and has been published in Ultrasonics 2023 ("Deep learning algorithm for predicting subacromial motion trajectory: Dynamic shoulder ultrasound analysis"). Two primary models are being considered for diagnosing subacromial impingement. The first approach involves tracking the motion of the greater tubercle relative to the acromion and generating a time-location curve. Subsequently, a deep learning algorithm will be developed to classify whether the time-location curve corresponds to participants with or without subacromial impingement. The second approach involves feeding the model individual images, each labeled as either subacromial impingement (+) or subacromial impingement (-). Data processing will occur at the individual level. In other words, if the majority of images from the same individual are classified as subacromial impingement (+), the entire batch of images from that individual will be labeled as subacromial impingement (+). Our algorithm will provide the highest risk of subacromial impingement based on the data from the two models.

Strength:

Dynamic ultrasound images of the shoulder joint have historically had limited clinical value due to a lack of quantitative assessment. Our team is the first to use image capture combined with mathematical algorithm techniques to quantify dynamic images of the acromion and humeral greater tubercle. We exclusively introduce parameters such as the vertical distance between the acromion and humeral greater tubercle, rotation radius, and rotation angle. Utilizing deep learning techniques, the required parameters are rapidly extracted without the need for manual operator input. Additionally, post-extraction, an artificial intelligence algorithm promptly determines the risk of subacromial impingement, providing reference information for physicians before and after intervention. This real-time feedback is then communicated to the patient. This represents an innovative approach in the current medical field, offering a forward-looking diagnostic and treatment process for shoulder pain.

Competing Products:

No

Intellectual Properties:

Our research team has extensive experience in the relevant applications of musculoskeletal ultrasound imaging. Since 2020, we have published nine papers that can be found on PubMed (https://pubmed.ncbi.nlm.nih.gov/?term=chang+kv+Lin+CY&sort=date)

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