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Multi-angle Intervertebral Disc View in Intelligent Lumbar Disease Diagnosis Using Deep Learning

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Introduction

The diagnosis of lumbar spine disorders has evolved considerably over the past few decades, owing largely to the integration of advanced imaging techniques and artificial intelligence. Among the various lumbar spine diseases, intervertebral disc degeneration, herniation, and other degenerative conditions are among the most prevalent, often leading to chronic pain, impaired mobility, and even disability. Traditionally, diagnosing such conditions relied heavily on clinical examination and static imaging, such as X-rays and magnetic resonance imaging. However, these methods alone can sometimes fail to provide sufficient insights, especially when the disc's condition is subtle or difficult to assess from a single perspective. In this context, the advent of multi-angle intervertebral disc imaging combined with deep learning techniques has opened new avenues for more accurate, automated, and efficient diagnosis of lumbar diseases. This article explores the role of multi-angle intervertebral disc views in intelligent lumbar disease diagnosis, focusing on how deep learning, particularly convolutional neural networks, can improve diagnostic precision, expedite the process, and offer new insights into the pathophysiology of spinal disorders [1,2].

Description

The intervertebral discs are complex structures that undergo changes in multiple planes of the spine. A single-angle view, such as the standard sagittal MRI scan, may not capture the full extent of pathological changes. For example, disc herniation might be visible in one plane but not in another, leading to an incomplete assessment. To address this, multi-angle imaging techniques have been developed. These techniques provide images of the discs from various angles, such as sagittal, axial, and coronal planes, enabling clinicians to view the disc from different perspectives and detect abnormalities that may not be apparent from a single view. In MRI, multi-angle imaging is often achieved by adjusting the imaging plane or using techniques such as 3D MRI, where multiple slices or volumes are combined into a composite view. This multi-dimensional view provides a much more comprehensive understanding of the disc's condition, improving the chances of detecting subtle or complex pathologies, especially when combined with advanced AI methods. Deep learning, particularly convolutional neural networks, has gained widespread attention in medical imaging, offering automated, scalable, and highly accurate diagnostic capabilities. CNNs are particularly effective in image analysis because they can automatically detect patterns and features in complex datasets, such as medical images, without needing explicit human intervention .

Conclusion

The combination of multi-angle intervertebral disc imaging with deep learning techniques offers a transformative approach to diagnosing lumbar spine diseases. By providing a more comprehensive and accurate analysis of the intervertebral discs, this approach can improve the detection of subtle pathologies, increase diagnostic precision, and reduce the reliance on human interpretation. While challenges remain, ongoing advancements in deep learning algorithms and the integration of diverse imaging modalities hold the potential to revolutionize lumbar disease diagnosis, making it faster, more accurate, and more accessible for patients around the world. As AI continues to mature, the future of spinal health care looks increasingly promising, with the potential for better patient outcomes through early diagnosis and tailored treatment plans.

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