Deep learning technique using magnetic resonance imaging in the diagnosis of meningioma and atypical meningioma

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I. INTRODUCTION

- In tumor treatment, the application of the above methodologies is selected complementarily by comprehensively considering benign or malignant nature, location, type, size, patient's age, etc., and both methods require accurate differentiation of the type and grade of the tumor. In particular, it is important to accurately diagnose whether meningiomas are benign or malignant.
- Artificial intelligence (AI), which is used in various fields recently, can be used more effectively in diagnosing meningiomas and atypical meningiomas. Deep learning can easily convey image patterns by learning optimal parameters from the input MRI data. This study sought to explore the possibility of an objective diagnostic technique that complements the problems of existing methods using deep learning with MRI data of meningiomas and atypical meningiomas.

II. MATERIALS and METHODS

- The image data is the internal MRI data of individuals diagnosed with meningioma and atypical meningioma at our institution from January 2015 to June 2023. We used images approved by the institutional review board (IRB) of Kyung Hee University for retrospective research (IRB No. 2022-06-035) (Fig. 1). We used ResNet101, a pre-trained model, for our convolutional neural network. We adjusted ResNet101 to classify meningioma and atypical meningioma, fixing the initial layers and readjusting the fully connected layer to output classification values.

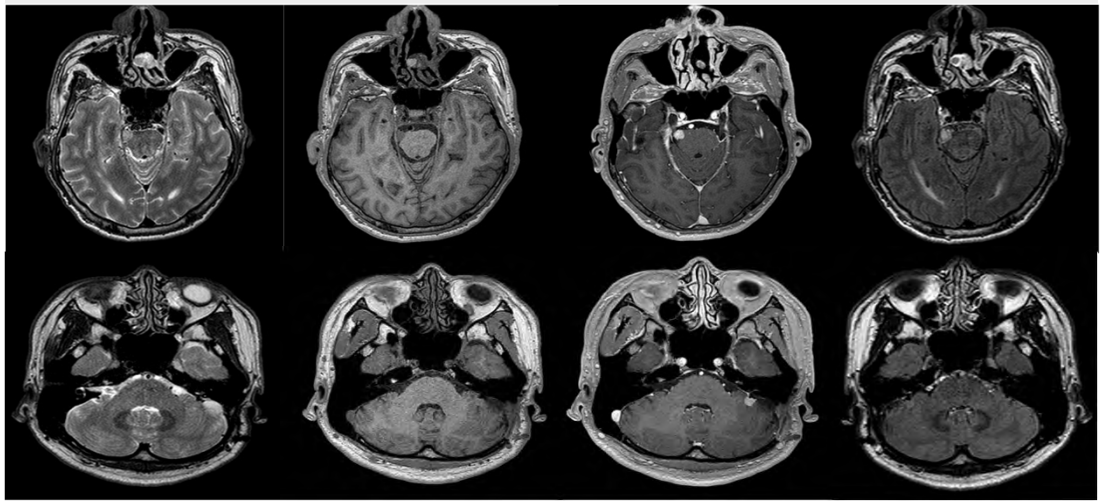

Fig. 1. The upper part is the MRI data of a typical meningioma, and the lower part is the MRI data of an atypical meningioma

III. RESULTS

- The dotted line connected by black dots indicates the accuracy and loss rate of the entire validation data according to each epoch, and the thin solid line indicates the changes in accuracy and loss rate within the mini batch. The bold solid line represents the change of the smoothing values of the thin solid lines (Fig. 2).

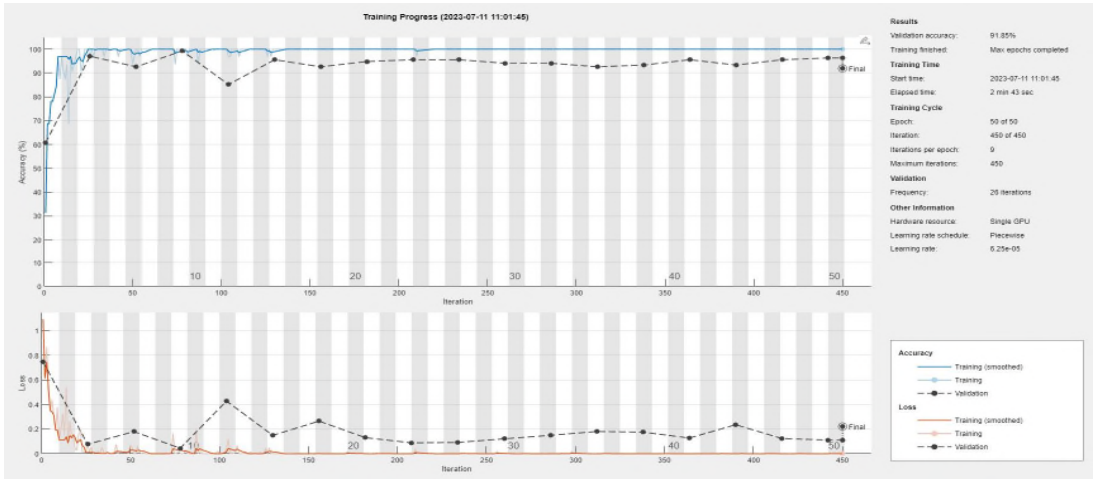

Fig. 2. The top is a diagram of the accuracy of transfer learning during training, and the bottom is a cross entropy loss

IV. DISCUSSION and CONCULSION

- This implies that deep learning shows excellent performance in classifying MRI data of meningioma and atypical meningioma. However, T2WI and CE-FLAIR showed somewhat lower specificity as misclassification increased, which is thought to reflect the image distortion problem inherent in the T2WI and CE-FLAIR inspection techniques themselves.
- In other words, deep learning showed inferior performance when using MRI data with relatively high image distortion compared to other inspection techniques. The limitations of this study include the lack of image data, the inability to adjust the weights appropriately for the diagnosis of meningioma and atypical meningioma, and the failure to apply additional methods that could improve accuracy and loss rate.
- In this study, we proposed an approach to diagnosing meningioma and atypical meningioma through deep learning. If existing methods cannot provide consistent and objectivity indicators for the diagnosis of meningioma, the application of deep learning can be used as a useful method to provide accurate diagnosis of meningioma.