Diagnosis of multiple sclerosis using optical coherence tomography supported by artificial intelligence:

Keywords:

Multiple sclerosis, Optical coherence tomography, Biomarker, Convolutional neural network

Multiple Sclerosis (MS) is a chronic autoimmune disorder that affects the central nervous system (CNS). It leads to progressive neurological impairment, often diagnosed through clinical symptoms, MRI scans, and cerebrospinal fluid analysis. However, these diagnostic methods have limitations in accessibility and early detection.

This study investigates the potential of **Optical Coherence Tomography (OCT)**, a non-invasive imaging technique, combined with **Artificial Intelligence (AI)**, to improve MS diagnosis.

علائم بالینی = clinical symptoms

تجزیه و تحلیل مایع مغزی نخاعی = cerebrospinal fluid analysis

Optical Coherence Tomography (OCT), a non-invasive imaging technique = توموگرافی انسجام نوری، یک تکنیک تصویربرداری غیر تهاجمی

3. Methodology

3.1 Optical Coherence Tomography (OCT) in MS Diagnosis

- OCT is a widely used imaging technique in ophthalmology that provides cross-sectional images of the retina.
- **استفاده از OCT**: این روش تصاویری دقیق از شبکیه چشم ارائه می‌دهد و نازک شدن لایه‌های عصبی را که در اماس رخ می‌دهد، نشان می‌دهد.
- MS-related neurodegeneration affects the retina, particularly the **ganglion cell layer (GCL)** and the **inner plexiform layer (IPL)**.
- Previous research suggests that retinal thinning correlates with MS progression.

3.2 AI Integration for Enhanced Diagnosis

- AI-based models were developed to analyze OCT images and detect MS-related changes.
- Machine learning techniques were applied to identify patterns in retinal layers associated with MS.

- The study trained AI models using a dataset of OCT scans from **MS patients and healthy controls**.

3.3 Data Collection & Patient Selection

- Participants included both MS patients and healthy individuals.
- High-resolution OCT scans of their retinas were collected.
- Data was divided into **training and validation sets** for AI model development.

4. Key Findings

4.1 Retinal Biomarkers for MS

- Significant **thinning of the ganglion cell layer (GCL) and inner plexiform layer (IPL)** was observed in MS patients.
- **نازک شدن لایه‌های شبکیه** (به‌ویژه لایه سلول‌های گانگلیونی و لایه داخلی شبکه‌ای) در بیماران اماس مشاهده شد.
- These changes correlated with disease severity and progression.
- The AI model was able to detect these microstructural alterations with **high precision**.

4.2 AI Model Performance

- AI-enhanced OCT analysis showed **higher sensitivity and specificity** compared to traditional diagnostic methods.
- The model demonstrated strong ability to distinguish between MS patients and healthy individuals.
- AI improved the consistency and reliability of OCT-based MS diagnosis.

4.3 Comparison with Traditional Methods

- Compared to **MRI scans and clinical assessments**, AI-based OCT analysis is **faster, cost-effective, and non-invasive**.
- The AI model provided more objective and quantifiable results than manual interpretations.

5. Conclusion & Clinical Implications

- **AI-supported OCT imaging** is a promising tool for MS diagnosis, especially for early detection.

- The technique could complement existing diagnostic methods, improving accuracy and reducing reliance on MRI.
- Future research should focus on **larger datasets** and **long-term monitoring** of MS patients using OCT.

برخلاف **MRI**که گران و گاهی ناراحت‌کننده است، روش OCT یک روش **سریع، بدون درد و ارزان‌تر** است. این می‌تواند **دسترسی بیماران بیشتری را به تشخیص زودهنگام ممکن کند،** به‌ویژه در مناطقی که امکانات پزشکی پیشرفته محدود است.

قاله تأکید زیادی بر این دارد که **تغییرات شبکیه چشم می‌تواند به‌عنوان یک نشانگر زیستی ارزشمند** برای پایش بیماری اماس استفاده شود. این یافته می‌تواند مسیر جدیدی را برای تحقیقات آینده در مورد **ارتباط بین سیستم عصبی مرکزی و شبکیه چشم** باز کند.