

Brain Volume Atrophy & White Matter Hyperintensities Quantification

FDA 510(k) Clearance



neurophet **AQUA**

ENG

About us

Established in 2016, Neurophet is specialized in the development of AI-driven brain image analysis solutions for diagnosis and guidance applicable through the entire treatment cycle. With a highly skilled and experienced team of researchers, developers, and medical directors, Neurophet collaborates with renowned university hospitals, research institutions, and global pharmaceutical companies on research initiatives.

Neurophet AQUA

Neurophet AQUA is a solution designed for analysis of a patient's brain MRI to provide precise and quick quantification of brain atrophy and white matter degeneration. It aids medical professionals in making accurate and prompt diagnosis of the neurodegenerative diseases such as Alzheimer's disease and vascular dementia by quantifying observed brain atrophy and white matter degeneration.

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Accurate Segmentation	
Reliable Technology	
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Product Overview

The Dice Similarity
Coefficient demonstrates
a performance of

91%¹⁾

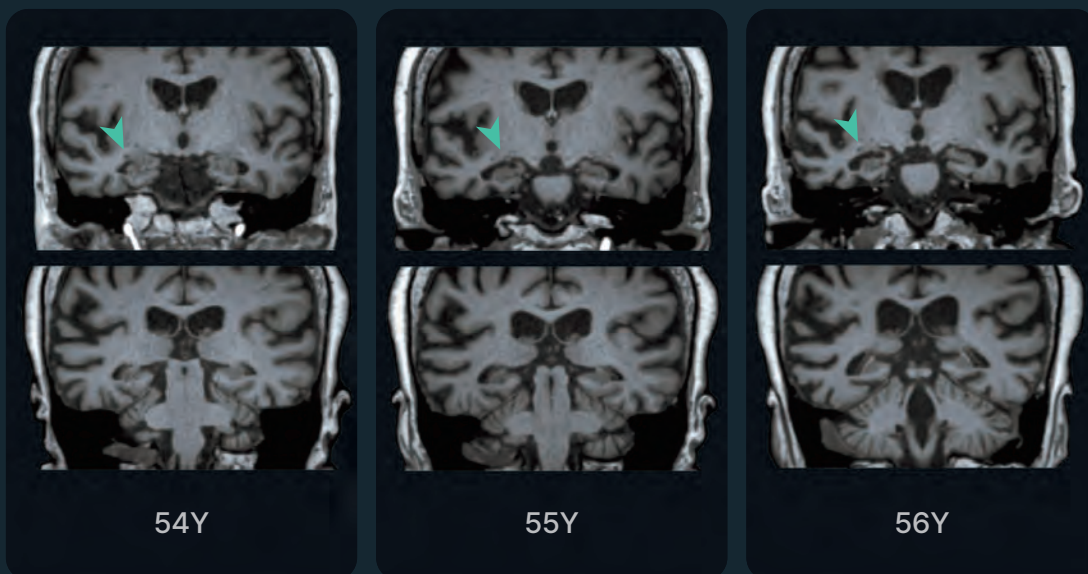
The processing time is
less than 5 minute for

126ROIs¹⁾



Accurate and efficient diagnosis with AQUA

Visual interpretation



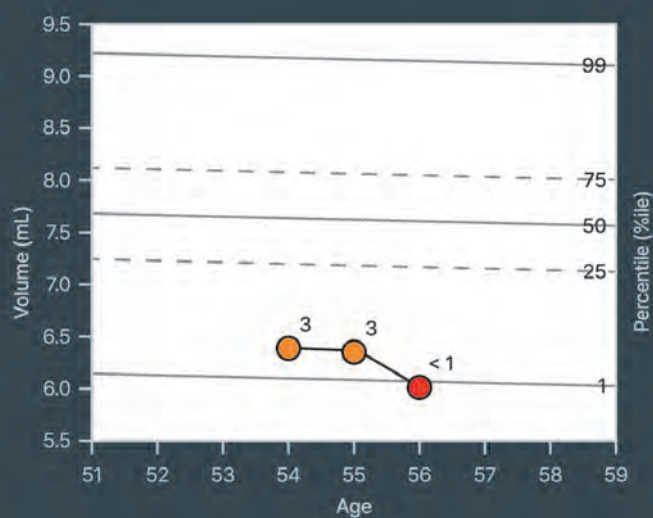
Segmentation by AQUA



Quantitative reports by AQUA

Research use only

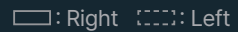
Longitudinal Change Graph²⁾



Age	%ile	Vol
54Y	3	6.43mL
55Y	3	6.39mL
56Y	< 1	6.02mL

AQUA provides a precise segmentation output even for small brain regions that are difficult to visually distinguish, like the hippocampus, enabling accurate volume analysis and quantitative numerical values for each brain region. This allows for clear and effective observation of changes in the examinee's brain regions.

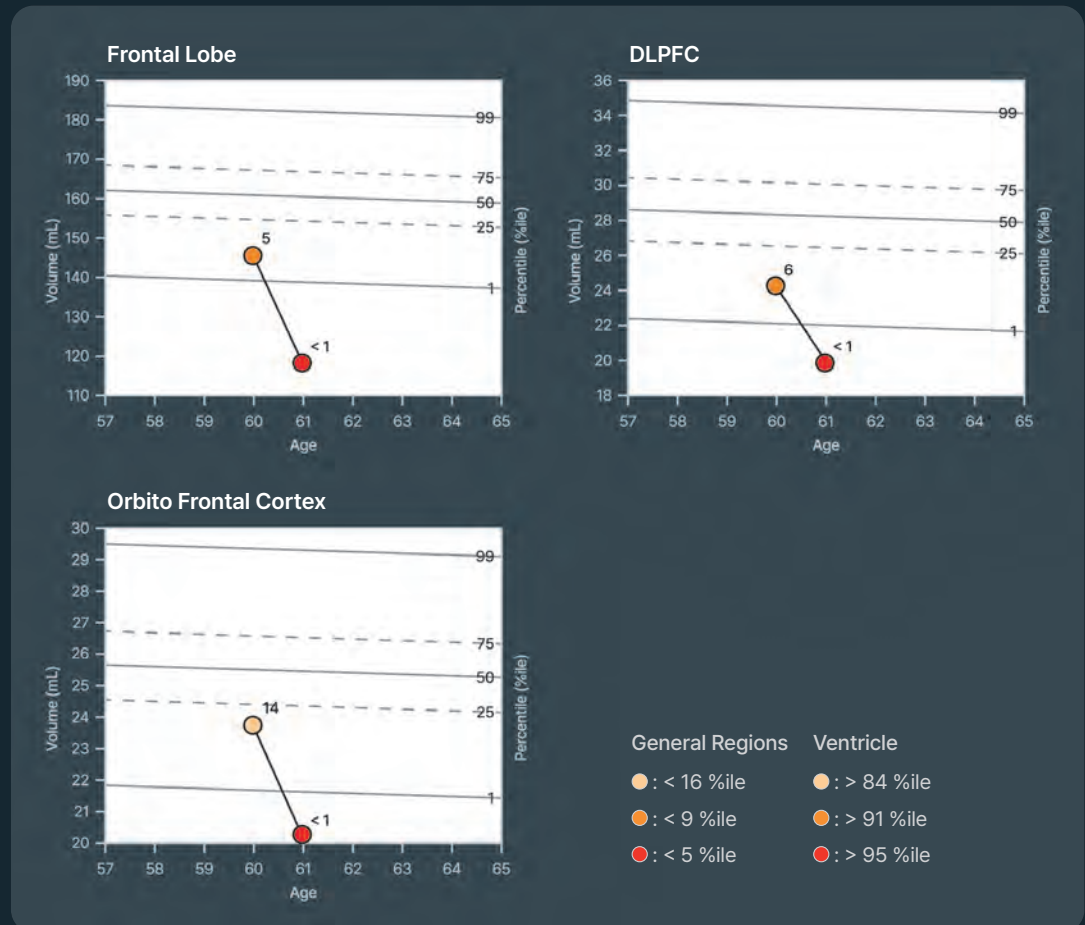
Brain atrophy radar chart



60Y	Evaluation		Compare RVs	Percentile (%ile)	Volume (mL)	% of ICV (%)
	Frontal Lobe	Total	↓↓↓	5	145.37	9.86
		Right	↓↓↓	4	72.77	4.94
		Left	↓↓	5	72.61	4.93
61Y	Evaluation		Compare RVs	Percentile (%ile)	Volume (mL)	% of ICV (%)
	Frontal Lobe	Total	↓↓↓	< 1	118.19	8.05
		Right	↓↓↓	< 1	59.29	4.04
		Left	↓↓↓	< 1	58.90	4.01

Longitudinal change graph

Research use only



An easy-to-read radar chart visualizes the pattern of neurodegeneration, assisting in the accurate classification of dementia subtypes. It can be used as an indicator to monitor the progression of neurodegenerative diseases and predict the rate of their change while tracking patient data in comparison to normative reference data.³⁾

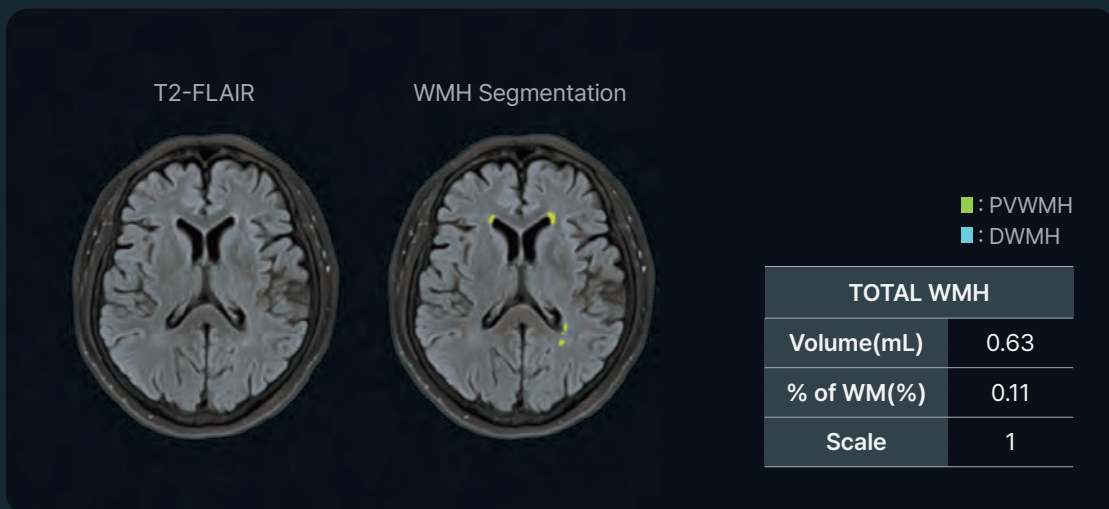
Product Feature

**Improving the accuracy of
reading FLAIR lesions**

WMH Quantification by AQUA

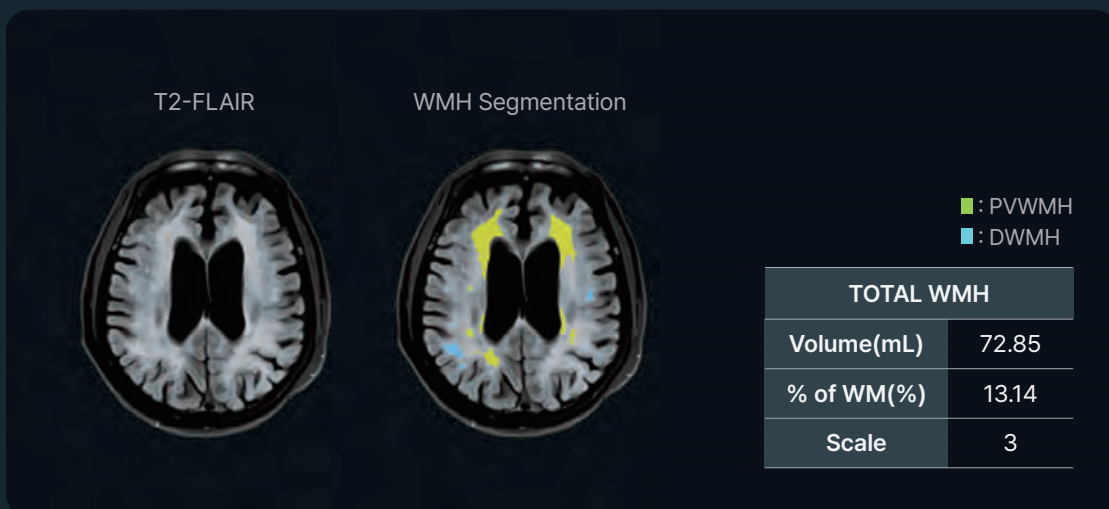
Normal

60Y



Abnormal

67Y



AQUA enables precise segmentation of brain lesions, making quantitative analysis possible using only T2 FLAIR images.⁴⁾ Additionally, it measures the volume of White Matter Hyperintensities (WMH) and scores severities based on the FAZAKES SCALE, allowing for accurate assessment and continued observation of the patient's condition.

AQUA Offers accurate and reliable brain imaging analyzing technology

Neurophet's segmentation performance

90.7%

AQUA achieves an impressive level of accuracy, closely aligning with the accuracy of radiologists' interpretations.¹⁾

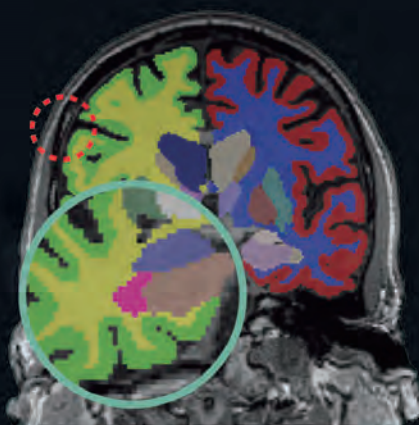
10,000_{cases}

Through the case studies with over 10,000 MR images, we have enhanced the accuracy of AI analysis algorithms.¹⁾

Neurophet's AI Model

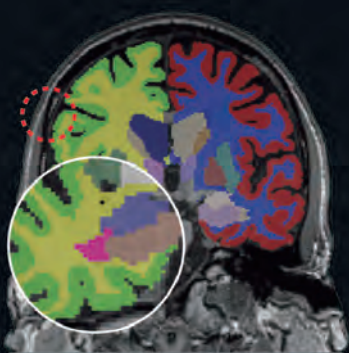
Fine-tuned SAU-Net*

*SAU-Net: Split-Attention U-Net



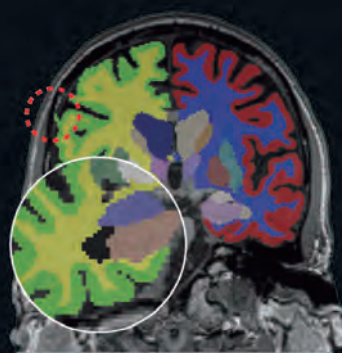
Ground-truth

Radiologist-based manual annotations



SOTA* Segmentation

*SOTA: State-of-the-Art



Scan Type: T1

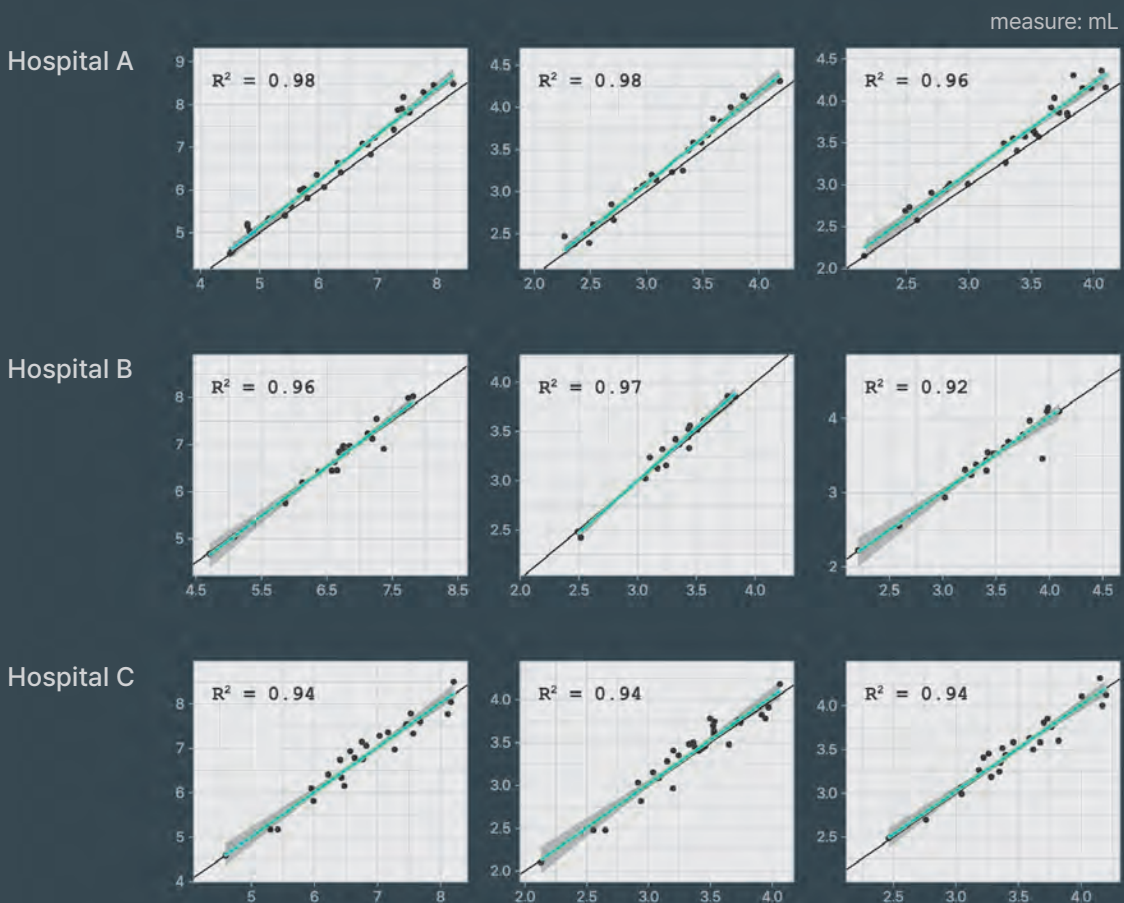
Evaluation	Experiment	Statistics	Results	Acceptable
Segmentation Performance ⁴⁾	Accuracy	Dice overlap* (%)	0.907 ± 0.055	> 0.80
		ASSD** (mm)	0.433 ± 0.136	< 1 mm
	Speed	Seconds (s)	28.361 ± 2.649	< 60 sec

*Dice overlap: Higher is better

**ASSD(Averages Symmetric Surface Distance): Lower is better

Multi-center, Multi-scanner Stability

We have implemented a reliable brain image analysis technology across various MRI scanners.²⁾



The charts demonstrate the consistency in hippocampal volume measurements conducted at three different hospitals.

16 different MRI scanners

Highly reliable brain image analysis is possible
even across different types of equipment.³⁾

1.5T, 3.0T_{MRI}

Capable of accurate analysis for all compatible types of images.³⁾

User Interview

Hyun-Kook Lim

Medical Doctor

Department of Psychiatry, Catholic University of
Korea Yeouido St. Mary's Hospital

Director of Brain Health Center in Catholic University of Korea

Ph.D. in Psychiatry, Catholic University of Korea

Recipient of the 2020 Minister of Health and Welfare Award for Dementia Contributions



“

Patients with dementia and cognitive impairments, along with their caregivers, seek to understand the patient's brain changes. AQUA reports offer quantitative analysis including longitudinal results, thereby assisting clinical practice by monitoring & predicting brain atrophy and enhancing patient communication.

”

Q1. How do you utilize AQUA in the medical field?

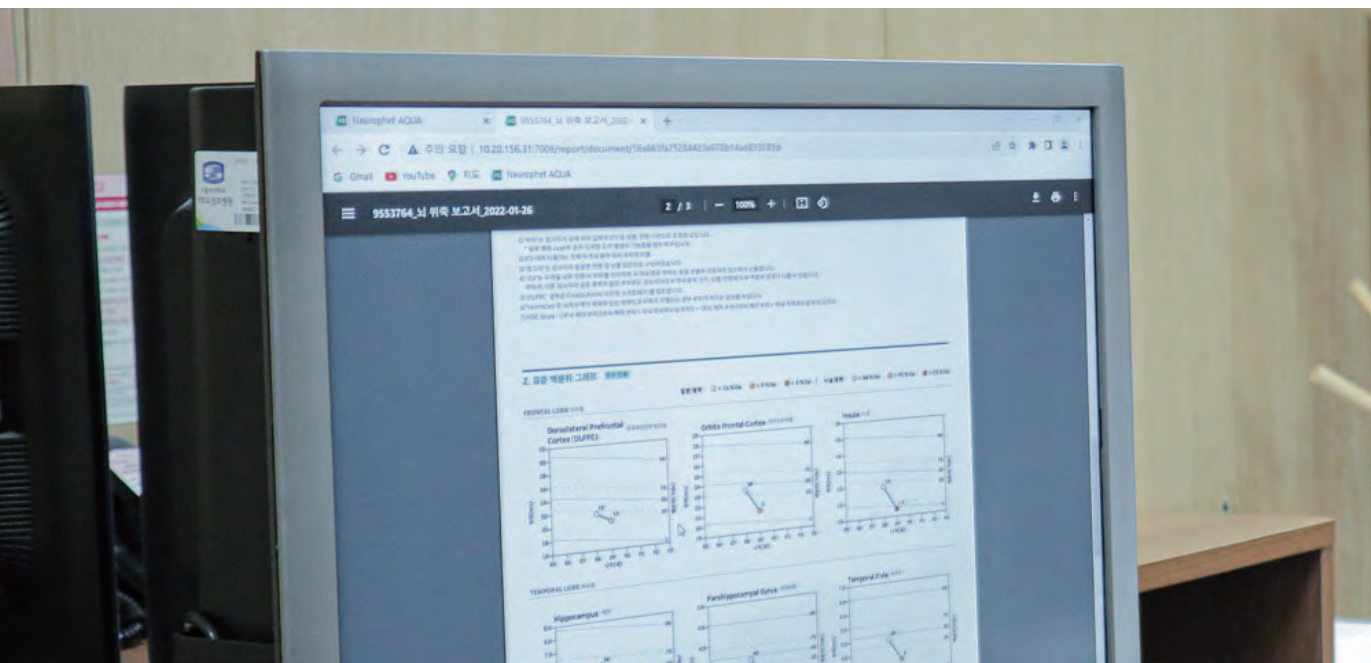
The patients I primarily see in my practice are those with conditions related to elderly mental health, such as dementia, cognitive impairments, and geriatric depression. One of the most critical aspects I focus on when treating these patients is brain atrophy. To objectively assess the degree of brain atrophy, I use AQUA as an adjunctive biomarker.

AQUA uniquely utilizes the normative reference data for Koreans, providing appropriate reference values for Koreans and enabling patients' longitudinal analyses. As it offers objective indicators for brain atrophy and White Matter Hyperintensity (WMH) Scale, I try to actively utilize it in the medical field.

Q2. How has AQUA been beneficial in the medical field?

The core feature of AQUA, longitudinal analysis provides quantified analysis results that allow for a detailed comparison of patients' conditions over time. This feature is not only valuable in clinical practice but also incredibly useful in communication with patients and their caregivers.

Longitudinal analysis extends to the analysis of brain atrophy and WMH, providing medical information on Alzheimer's and other degenerative brain diseases as well as insights into patients' brain atrophy patterns and disease progression. It is particularly helpful in predicting prognosis by measuring the rate of progression from mild cognitive impairment to dementia.



Q3. How has patient care been improved through the utilization of AQUA?

In the medical field, there are many equivocal cases that are difficult to diagnose with visual inspection alone. However, AQUA, a quantitative brain analysis tool, allows healthcare providers to measure the rate and trajectories of brain atrophy, boosting their confidence in predicting patient outcomes and determining treatment directions for dementia and cognitive impairment patients. Additionally, patients can directly recognize changes in their own brain health using AQUA.

AQUA can be used as an indicator to assess brain reserve and rate of disease progression through predicted brain age and atrophy patterns. This approach is applicable to a wide range of patients, including those with dementia, Alzheimer's disease, and elderly individuals with depression. Research is ongoing to expand the use of AQUA to other neurological and psychiatric disorders.



Q4. How do you plan to utilize AQUA in the future?

I'm planning to use AQUA to conduct quantitative analysis of real clinical cases to study brain reserve indicators.

This will enable us to predict and monitor treatment effects and side effects when introducing DMT for neurodegenerative diseases in the future. For example, we intend to quantitatively assess the degree of brain atrophy, its impact, and the recovery process after the use of therapeutic agents.

Such information could have a significant impact on the development of dementia treatments and is expected to be utilized as a biomarker.

User Benefits

**AQUA supports
all of your medical needs**

*What are the major benefits
of using AQUA?*

Providing benefits for everyone,

**from Specialists
—— to Patients**

AQUA supports all of your medical needs

AQUA

Specialist



Benefits for Specialist

*Research use only

Early diagnosis of degenerative brain diseases

- Calculation of volumes for 187 brain regions in the left and right hemispheres and provision of pattern charts
- Quantification of white matter lesions and calculation of FAZEKAS scale
- Predicting brain atrophy rate and tracking change trends through longitudinal analysis
- A total of 9 diverse reports to support diagnosis

Patient

care
& continuity



Precise interpretation from a radiological perspective

- Identification of subtle changes and patterns in brain volume and lesions
- Automated image quality check
- Automatic generation of interpretation sentences in reports
- Image viewer with image effect controls
- Transfer of reports and analyzed images to PACS

Rapid and effective processing for research

- Automated workflows
- Analysis completion within 5 minutes
- Export of analysis results in CSV

Clinical Utilization of AQUA

CASE REPORT⁵⁾

Case 1

23-27

Infomation	23
Initial Visit	24
After 4Yr F/U	26

Case 2

29-33

Infomation	29
Initial Visit	30
After 4Yr F/U	32

Go to article



Case 1

Amnestic MCI with objective memory impairment

Age / Sex	75Year / Female
Chief Complaint	Memory disturbance started from 2~3 years ago
Subjective Data	<p>"I underwent basic cognitive function tests at a nearby Dementia Care Center before the visit.¹⁾"</p> <p>"I have difficulty in finding things and abstract thinking."</p> <p>"I am becoming increasingly anxious due to my worsening symptoms."</p>
Objective Data	<ul style="list-style-type: none"> - CERAD-K < 1.5SD : Reduced word list memory, word list recall, word list recognition - CDR : 0.5 / CDR-SB : 3 - Amyloid PET : Positive - APOE : ε4/ε4
Assessment	Amnestic MCI with objective memory impairment

1) A nationwide public center run by the Ministry of Health and Welfare in South Korea for dementia management, cognitive enhancement, and dementia prevention programs

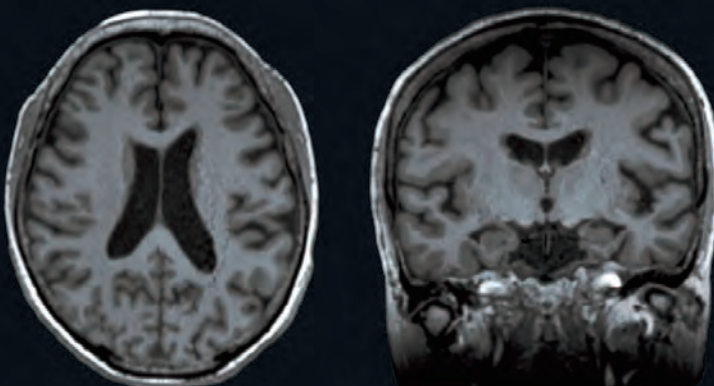
Case 1: Amnestic MCI with objective memory impairment

75Year / Female

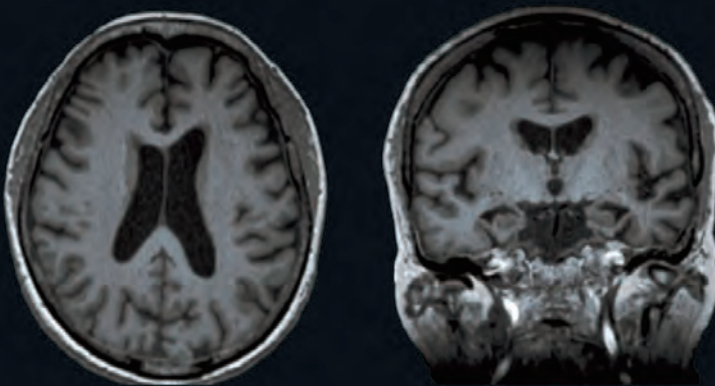
2018 Intial Visit ————— 2019 ——— 2020 ——— 2021

2018

CDR: 0.5
CDR-SB: 3
Amnestic MCI



2021



Aqua brain atrophy report

Region		Compare RVs	Percentile (%ile)	Volume (mL)	% of ICV (%)	Z-Score	Reference Values (RVs)	
							Mean (mL)	SD
Hippocampus	Total	↓↓↓	< 1	4.83	0.32	-3.54	7.16	0.66
	Right	↓↓↓	< 1	2.57	0.17	-3.22	3.69	0.35
	Left	↓↓↓	< 1	2.26	0.15	-3.48	3.47	0.35
Parahippocampal Gyrus	Total	↓↓↓	< 1	2.61	0.17	-2.99	3.70	0.37
	Right	↓↓↓	< 1	1.34	0.09	-2.60	1.82	0.18
	Left	↓↓↓	< 1	1.26	0.08	-2.77	1.88	0.22
Temporal Pole	Total	↓↓↓	1	3.80	0.25	-2.31	5.18	0.60
	Right	↓↓↓	4	2.01	0.13	-1.80	2.59	0.32
	Left	↓↓↓	1	1.78	0.12	-2.23	2.59	0.36
Insula	Total	↓↓	5	11.84	0.80	-1.64	13.35	0.92
	Right	↓↓	7	5.82	0.39	-1.50	6.53	0.47
	Left	↓↓	5	6.02	0.41	-1.64	6.82	0.49
Region		Compare RVs	Percentile (%ile)	Score (%)	% of ICV (%)	Z-Score	Reference Values (RVs)	
							Mean (mL)	SD
Hippocampal Occupancy Score(HOC)		↓↓↓	3	0.12	-	-1.77	0.26	0.08

AQUA brain atrophy report shows the results of a brain atrophy analysis adjusted for intracranial volume, age, and sex.

At the Initial visit, AQUA analysis reported significant atrophy in bilateral hippocampi, parahippocampal gyri, temporal poles(all under 1%ile). In addition, mild atrophy in the bilateral insula(Rt: 7%ile, Lt: 5%ile) and right posterior cingulate cortex(3%ile) was observed with the HOC of 3%ile. This allows for fast and easy comparative analysis of quantified brain atrophy with a normative database.

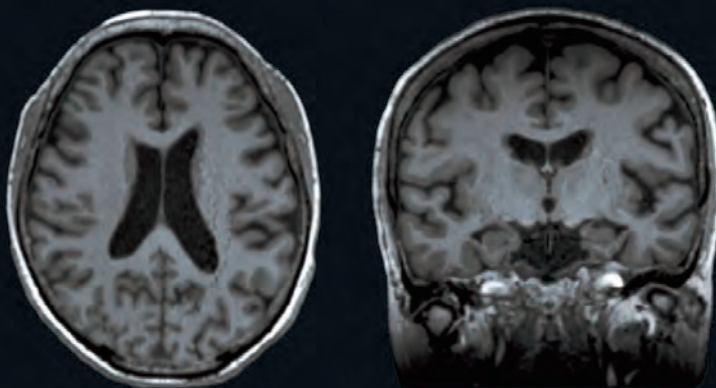
Case 1: Amnestic MCI with objective memory impairment

75Year / Female

2018 — 2019 — 2020 — **2021 After 4Yr F/U**

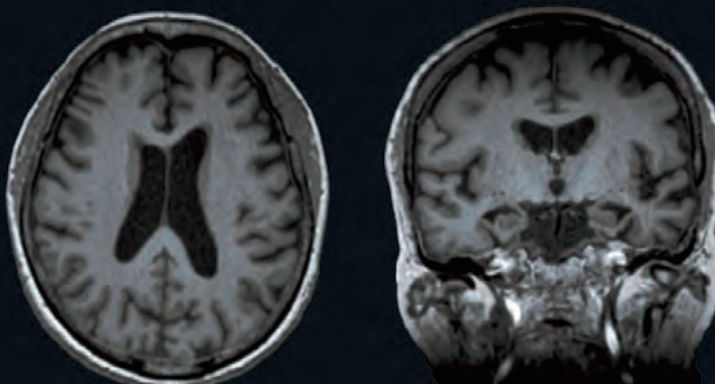
2018

CDR: 0.5
CDR-SB: 3
Amnestic MCI

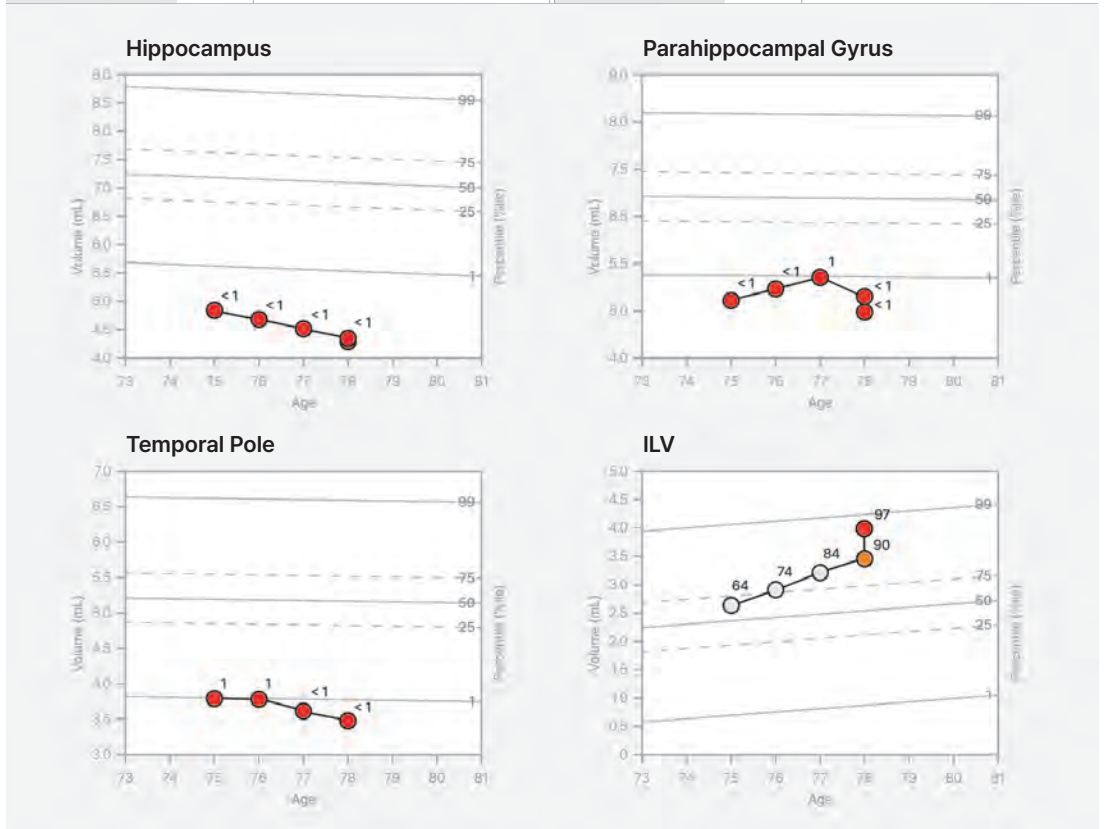


2021

CDR: 1(▲)
CDR-SB: 4(▲)
Alzheimer Disease



Region		Compare RVs	Percentile(%ile)	Region		Compare RVs	Percentile(%ile)
Hippocampus	Total	↓↓↓	< 1	ILV	Total	↓	90
	Right	↓↓↓	< 1		Right		79
	Left	↓↓↓	< 1		Left	↓↓	94
Insula	Total	↓↓↓	4	Hippocampal Occupancy Score(HOC)	Total	↓↓↓	2
	Right	↓↓↓	1				
	Left	↓	12				



AQUA longitudinal reports provide the ability to compare images of the same patient at multiple points in time to track changes.

On the follow-up of 4 years after, AQUA analysis showed atrophy progression in the bilateral insula and expansion in bilateral regions, with a lower HOC. This case demonstrates atrophy in the bilateral hippocampi and medial temporal lobes, consistent with typical AD subtype findings.

AQUA supports in diagnosing equivocal cases through visual inspection and correlates imaging with clinical symptoms.

CASE REPORT

Case 2

Typical AD with objective memory impairment & ADL

Age / Sex	79Year / Male
Chief Complaint	a rapid progression of memory dysfunction and disability in daily life performances that began a year ago
Objective Data	<ul style="list-style-type: none">- Diagnosed with MCI 5 years ago, but did not receive regular checkups or treatment.- DM(+), HTN(+): Strictly management- CERAD-K(Initial visit) < 1.0 SD : All domains including memory, attention, and executive function.- CDR : 1 / CDR-SB : 4.5- APOE : ε3/ε3- Amyloid PET : Positive
Assessment	Typical AD dementia patient with objective impairment in memory and ADL

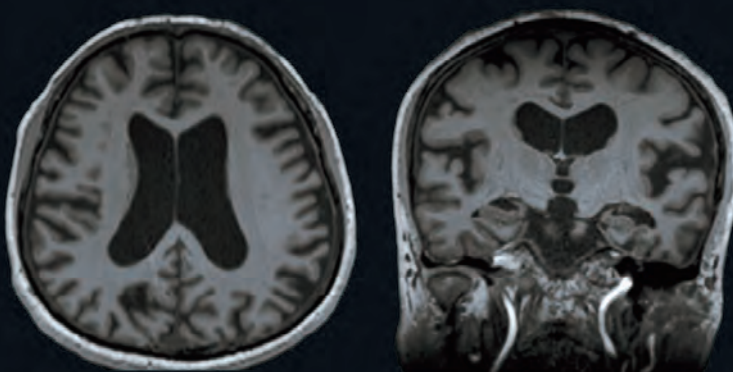
Case 2: Typical AD with objective memory impairment & ADL

79Year / Male

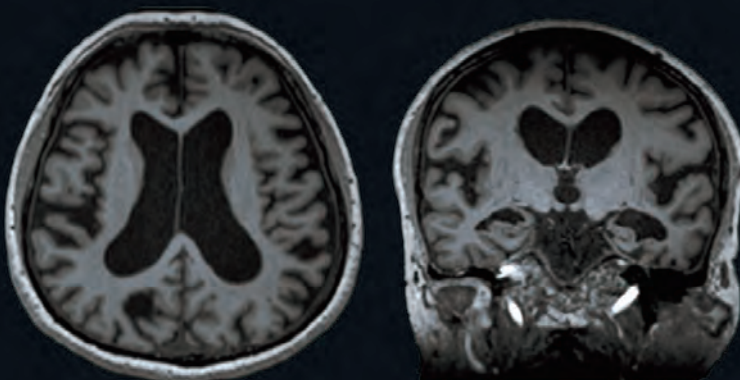
2018 Intial Visit ————— 2019 — 2020 — 2021 — 2022

2018

CERAD-K: 50
CDR: 1
CDR-SB: 4.5
Amnesic MCI



2022



Aqua brain atrophy report

Region		Compare RVs	Percentile (%ile)	Volume (mL)	% of ICV (%)	Z-Score	Reference Values(RVs)	
							Mean(mL)	SD
Hippocampus	Total		18	6.56	0.39	-0.93	7.18	0.66
	Right		40	3.60	0.21	-0.26	3.69	0.35
	Left	↓↓↓	7	2.96	0.18	-1.51	3.49	0.35
Parahippocampal Gyrus	Total	↓↓↓	<1	2.70	0.16	-2.89	3.77	0.37
	Right	↓↓↓	<1	1.41	0.08	-2.39	1.85	0.18
	Left	↓↓↓	<1	1.29	0.08	-2.78	1.92	0.22
Temporal Pole	Total	↓	11	4.50	0.26	-1.25	5.25	0.60
	Right		51	2.66	0.16	0.03	2.65	0.32
	Left	↓↓↓	2	1.84	0.11	-2.11	2.60	0.36
Insula	Total		24	12.61	0.76	-0.70	13.25	0.92
	Right		38	6.35	0.38	-0.31	6.50	0.47
	Left	↓	15	6.26	0.38	-1.02	6.76	0.49
Region		Compare RVs	Percentile (%ile)	Score (%)	% of ICV (%)	Z-Score	Reference Values(RVs)	
							Mean(mL)	SD
Hippocampal Occupancy Score(HOC)		↓↓↓	1	0.07	-	-2.27	0.23	0.07

This is a case of typical AD dementia, a 79-year-old male patient.

The patient showed cognitive impairment in all areas, including memory, attention, executive function, and difficulty performing ADL.

AQUA analyzed significant atrophy in bilateral para-hippocampal gyri and left temporal pole(all under 1%ile), and mild atrophy in the left insula(15%ile). Significant widening of bilateral ILVs(over 99%ile) was also confirmed, with the HOC of 1%ile.

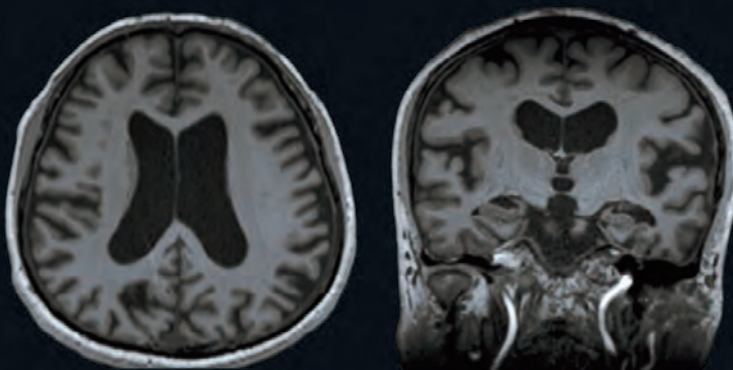
Case 2: Typical AD with objective memory impairment & ADL

79Year / Male

2018 — 2019 — 2020 — 2021 — **2022** After 5Yr F/U

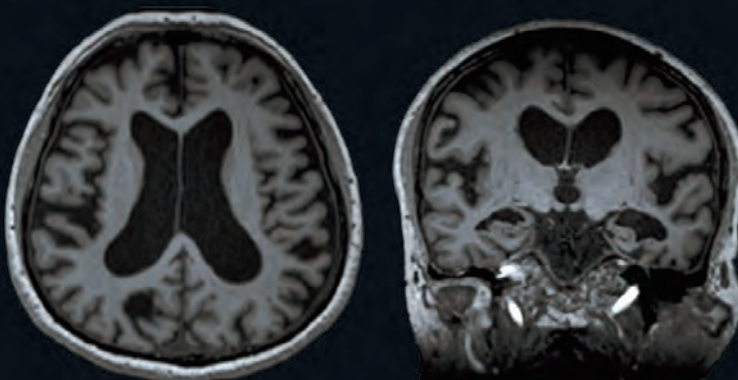
2018

CERAD-K: 50
CDR: 1
CDR-SB: 4.5
Amnesic MCI

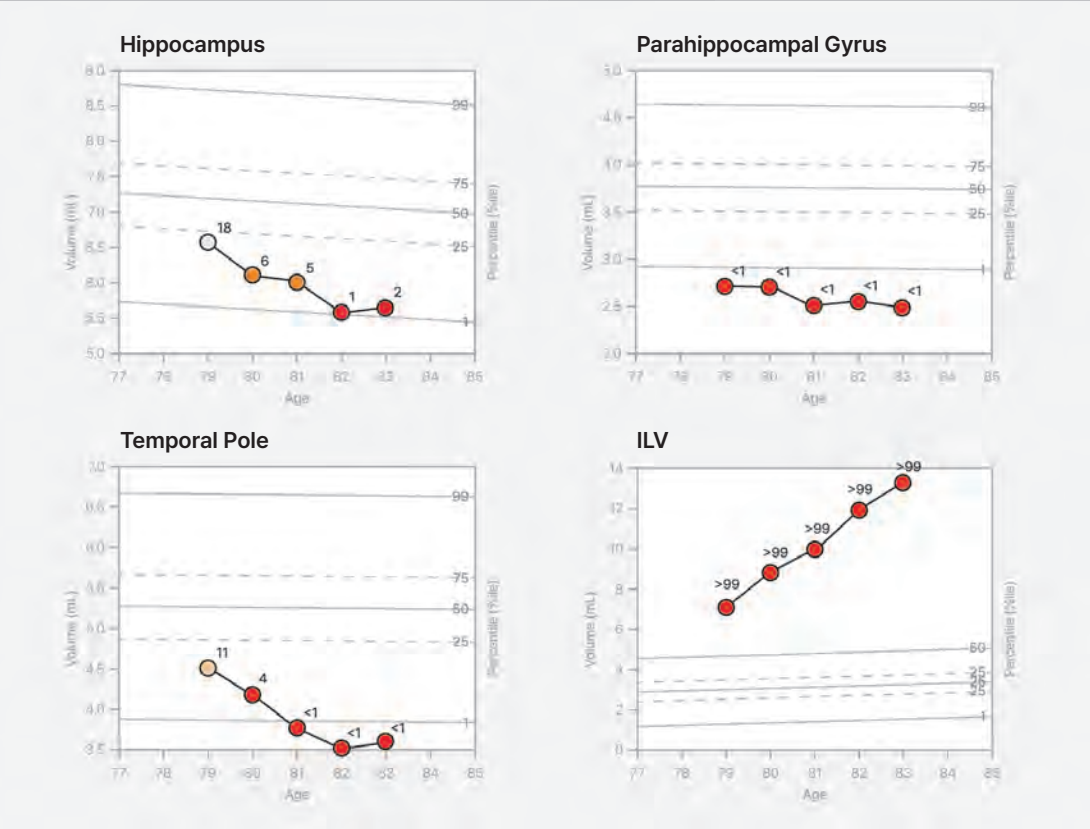


2022

CERAD-K: 19(▼)
CDR: 2(▲)
CDR-SB: 14(▲)
Alzheimer Disease



Region		Compare RVs	Percentile(%ile)	Region		Compare RVs	Percentile(%ile)
Hippocampus	Total	↓↓↓	2	ILV	Total	↓↓↓	> 99
	Right	↓	13		Right	↓↓↓	>99
	Left	↓↓↓	< 1		Left	↓↓↓	>99
Insula	Total	↓	11	Hippocampal Occupancy Score(HOC)	Total	↓↓↓	1
	Right		32				
	Left	↓↓↓	3				



Aqua reports can help you correlate clinical deterioration with atrophy progression for a more accurate diagnosis.

Over 5 years of annual follow-up, AQUA analyzed a typical pattern of progressive decrease in hippocampal, parahippocampal, and temporal pole volumes and widening of the ILV, which correlated with worsening Alzheimer's disease-related symptoms.

Meet the Neurophet, Try AI Solution

Experience our innovative technology
Go to page: www.neurophet.com



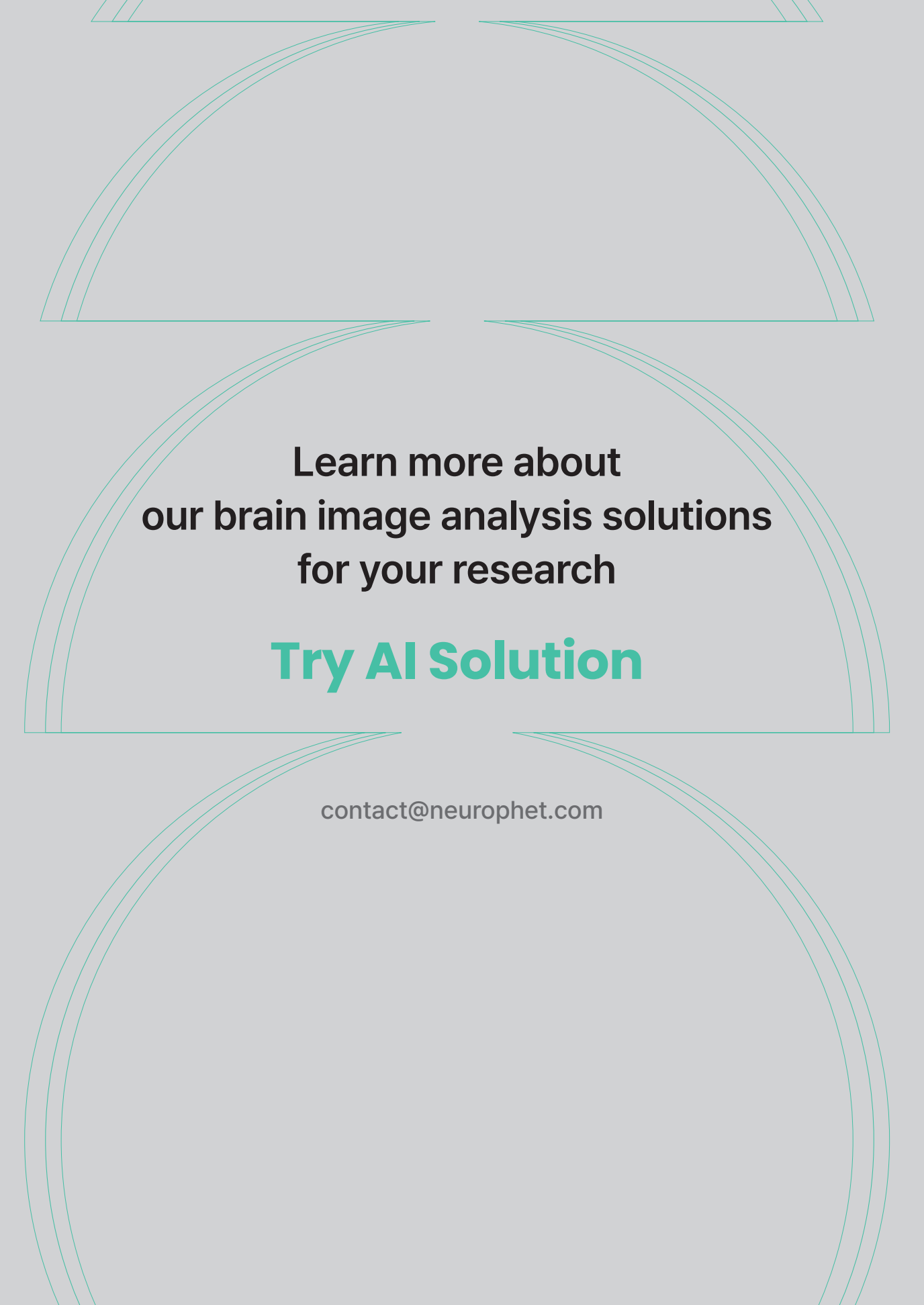
Neurophet Inc.

T. +82 2 6954 7971

F. +82 2 6954 7972

E. contact@neurophet.com

12F, 124, Teheran-ro, Gangnam-gu,
Seoul, Republic of Korea

The background features four large, overlapping teal arcs that form a circular shape in the center. Each arc is composed of three parallel lines.

**Learn more about
our brain image analysis solutions
for your research**

Try AI Solution

contact@neurophet.com

Overcome brain disorders with advanced neuroscience

Neurophet is collaborating on research with organizations such as Korea Disease Control and Prevention Agency (KDCA) and Korea Dementia Research Center (KDRC). We are also contributing to clinical research through partnerships with approximately 20 major domestic university hospitals, including Seoul National University Hospital, Samsung Medical Center in Seoul, and Seoul St. Mary's Hospital.

We try to expand our global business to countries including the UK, UAE, Switzerland, Japan, and Singapore. Through research activities and collaborative clinical studies, we are evolving into a global company.

Neurophet AQUA

US- FDA 510(k) cleared

CE Marked

MFDS(Korea) Approved

MHLW(Japan) Approved

HSA(Singapore) Approved



Reference

- 1) Lee, Minho, et al. "Split-attention U-Net: a fully convolutional network for robust multi-label segmentation from brain MRI." *Brain Sciences* 10.12 (2020): 974.
- 2) Neurophet intra validation data
- 3) Kim, Regina EY, et al. "Deep learning-based segmentation to establish East Asian normative volumes using multisite structural MRI." *Diagnostics* 11.1 (2020): 13.
- 4) ZunHyan Rieu, et al. "MRI Segmentation:Brain Tissue with White Matter Hyperintensity SegmentationUsing FLAIR MRI", *Brain Sci.*2021,11, 720
- 5) Kim, H. W., Rieu, J., Kim, D. H., & Lim, H. K. (2023). Clinical utilization of brain magnetic resonance imaging-based artificial intelligence software in the spectrum of Alzheimer's disease: Case series. *Journal of the Korean Neuropsychiatric Association*, 62(2), 86-94. doi:10.4306/jknpa.2023.62.2.86



Contact

T. +82 2 6954 7971 F. +82 2 6954 7972

E. contact@neurophet.com

www.neurophet.com