RSNA Press Release

Pro Fighters Risk Damage to the Brain's 'Garbage Disposal'

Released: November 26, 2025

At A Glance

- The waste-clearing glymphatic system in a professional fighter significantly declines in function with repeated head impacts.
- The glymphatic system is a network of fluid-filled channels that plays a crucial role in clearing waste products from the brain.
- Repeated head impacts are risk factors for neurodegenerative disorders, such as dementia.

CHICAGO – The brain's waste-clearing system significantly declines in function with repeated head impacts, according to a new study of cognitively impaired professional boxers and mixed martial arts fighters. The findings will be presented next week at the annual meeting of the Radiological Society of North America (RSNA).

Dhanush Amin, M.D.

Sports-related traumatic brain injuries account for up to 30% of all brain injury cases, and boxing and mixed martial arts are major contributors. Repeated head impacts are risk factors for neurodegenerative and neuropsychiatric disorders.

The glymphatic system is a network of fluid-filled channels that plays a crucial role in clearing waste products from the brain. It is comparable to the lymphatic system in other parts of the body.

"The recently discovered glymphatic system is like the brain's plumbing and garbage disposal system," said Dhanush

Amin, M.D., lead author of the study conducted by researchers from the University of Alabama at Birmingham and Cleveland Clinic Nevada. “It’s vital for helping the brain flush out metabolites and toxins.”

Diffusion tensor imaging along the perivascular space (DTI-ALPS) is a specialized MRI technique that measures and analyzes water movement in and around the spaces that surround the channels of the glymphatic system. These spaces, which serve as drainage pathways, also regulate fluid balance, transport nutrients and immune cells, and protect the brain from damage.

The DTI-derived ALPS index is a non-invasive biomarker that assesses glymphatic function. An impaired DTI-ALPS index can be a marker for cognitive decline and is associated with the progression of conditions like Alzheimer’s and Parkinson’s disease.

“When this system doesn’t work properly, damaging proteins can accumulate, which have been linked to Alzheimer’s and other forms of dementia,” said Dr. Amin, now an assistant professor of neuroradiology at the University of Arkansas for Medical Sciences. “Studying this system gives us a new window into understanding and possibly slowing memory loss.”

The researchers analyzed baseline data from Cleveland Clinic’s Professional Athletes Brain Health Study (PABHS), a longitudinal study of approximately 900 active fighters of which roughly 300 professional fighters have been followed for at least three years. The study included data from 280 fighters, 95 of whom were cognitively impaired at baseline, and 20 demographically matched healthy controls.

DTI-ALPS was computed on the athletes and controls. Using the DTI-ALPS method, the researchers assessed the athletes’ glymphatic activity over time and the correlation between the DTI-derived ALPS index and the number of knockouts experienced. They also measured the difference in glymphatic activity between cognitively impaired and non-impaired athletes.

“We thought repeated head impacts would cause lower ALPS in cognitively impaired fighters compared to non-impaired fighters,” Dr. Amin said. “We also expected the ALPS measurement to be significantly correlated with the total number of knockouts in the impaired fighters.”

Contrary to their hypothesis, the researchers observed a significantly higher glymphatic index among impaired fighters that deteriorated over time with the total number of knockouts. In athletes with continued trauma, glymphatic function significantly declined.

“We believe that the glymphatic index was initially high in the impaired athlete group because the brain initially responds to repeated head injuries by ramping up its cleaning mechanism, but eventually, it becomes overwhelmed,” Dr. Amin said. “After a certain point, the brain just gives up.”

Non-impaired fighters had a significantly lower right and total glymphatic index compared to impaired fighters. The relationship between the glymphatic index and knockout history was significantly different between the two groups.

Dr. Amin said that understanding the impact of repeated head impacts on the glymphatic system is crucial for the early detection and management of neurodegenerative risk in athletes participating in contact sports.

“If we can spot glymphatic changes in the fighters before they develop symptoms, then we might be able to recommend rest or medical care or help them make career decisions to protect their future brain health,” he said.

Co-authors are Gaurav Nitin Rathi, M.S., Charles Bernick, M.D., and Virendra Mishra, Ph.D.

Note: Copies of RSNA 2025 news releases and electronic images will be available online at *RSNA.org/press25*.

RSNA is an association of radiologists, radiation oncologists, medical physicists and related scientists promoting excellence in patient care and health care delivery through education, research and technologic innovation. The Society is based in Oak Brook, Illinois. (*RSNA.org*)

Editor’s note: The data in these releases may differ from those in the published abstract and those presented at the meeting, as researchers continue to update their data right up until the meeting. To ensure you are using the most up-to-date information, please call the RSNA Newsroom at 1-312-791-6610.

For patient-friendly information on brain MRI, visit *RadiologyInfo.org*.

Video (MP4):

Video 1. Patient being positioned for a brain MRI.
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Video 2. Patient completing brain MRI.
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Video 3. Dhanush Amin, M.D., discusses his research on cognitively impaired professional boxers and mixed martial arts fighters and how the brain's waste-clearing system significantly declines in function with repeated head impacts.
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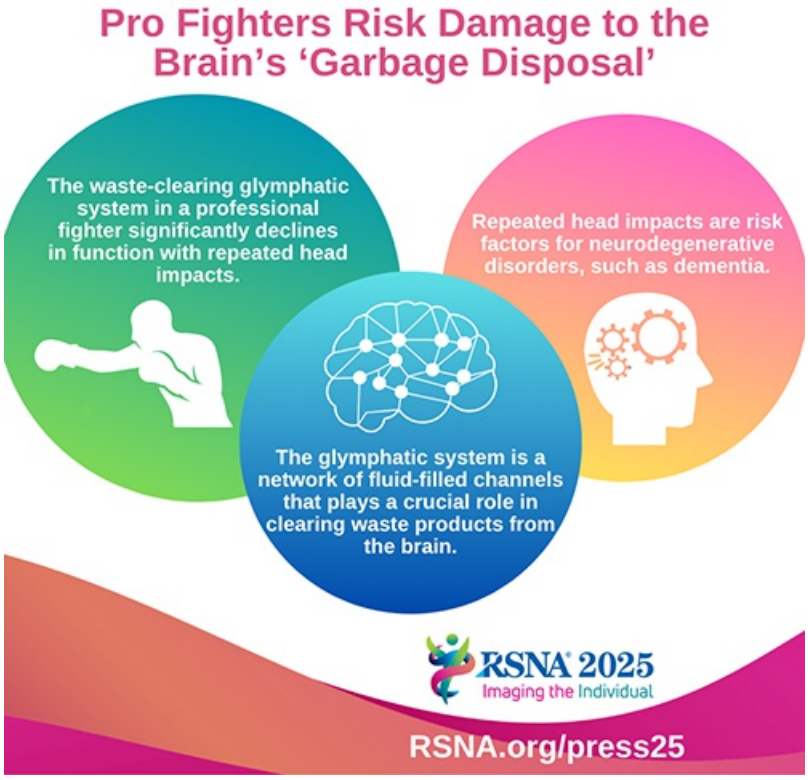
Images (JPG, TIF):



Infographic

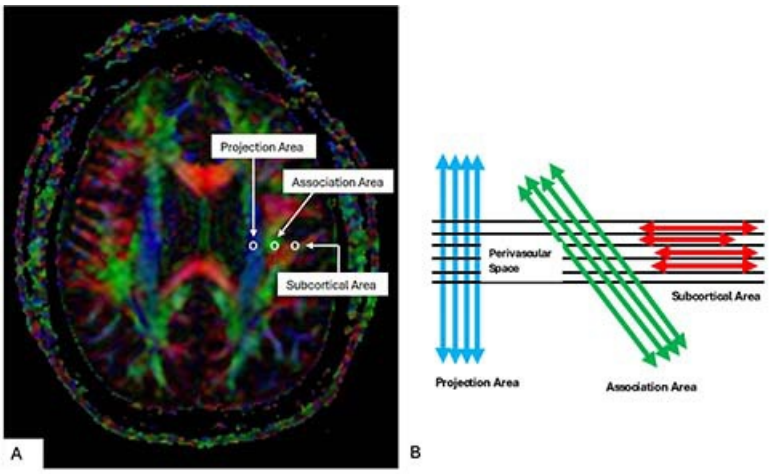


Figure 1. (A) Color display of diffusion tensor imaging indicating the distribution of projection fibers (z-axis: blue), association fibers (y-axis: green), and the subcortical fibers (x-axis: red). Three regions of interest are placed in the area with projection fibers (projection area), association fibers (association area), and subcortical fibers (subcortical area) to measure diffusivities of the three directions (x, y, z). **(B)** Schematic indicating the relationship between the direction of the perivascular space (black lines) and the directions of the fibers.

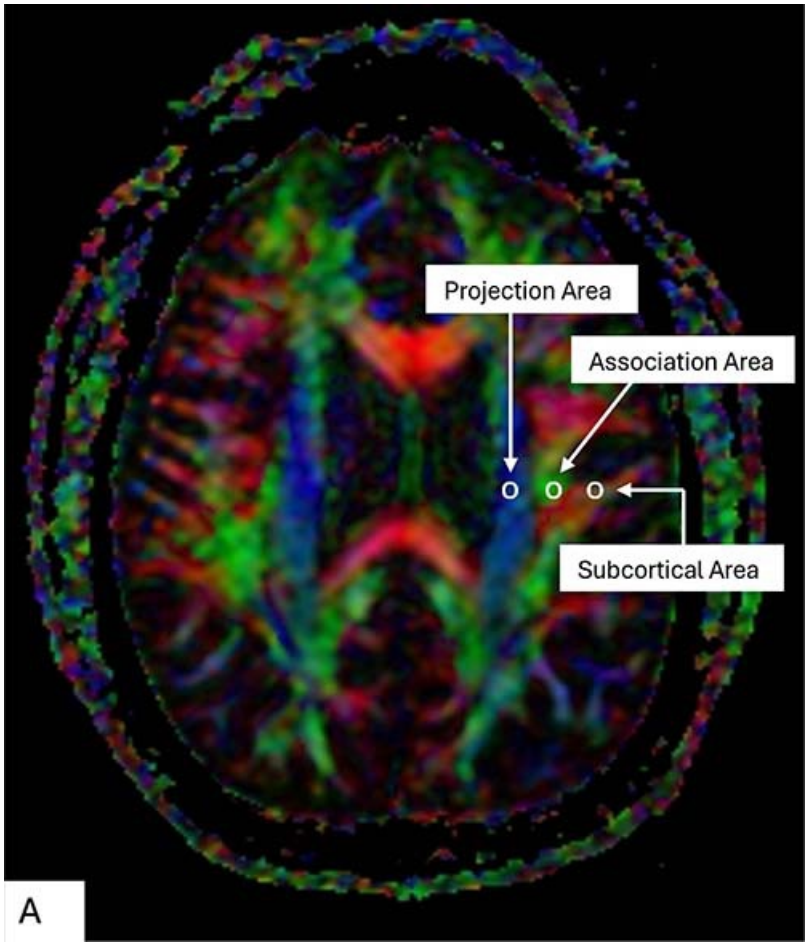


Figure 2. Color display of diffusion tensor imaging indicating the distribution of projection fibers (z-axis: blue), association fibers (y-axis: green), and the subcortical fibers (x-axis: red). Three regions of interest are placed in the area with projection fibers (projection area), association fibers (association area), and subcortical fibers (subcortical area) to measure diffusivities of the three directions (x, y, z).

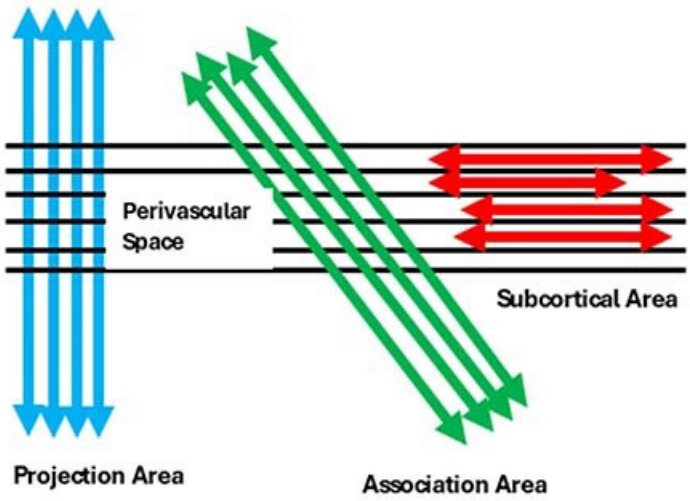


Figure 3. Schematics indicate the relationship between the direction of the perivascular space (black lines) and the directions of the fibers.

Resources:

Abstract