Magnetic Resonance Imaging of the Brain and Its Role in Early Detection of Brain and Nerve Diseases

By

Dalal Hassan Mohammed Qahwaji*
*Radiology Technician East Jeddah Hospital/ jeddah
Mohannad Hussein Alawi Alkard**
**Radiology technician , Health Monitoring Centers at King Abdulaziz Airport/ Jeddah
Mohammed Ali Salem Alqhtani***
***Non-Physician Radiologist Namirah General Hospital / Al Qunfudhah
Ibrahim Ali Alhabaidi****
****Radiology Technician, Health Monitoring Centers at King Abdulaziz Airport/ Jeddah
Atef Mohammed Abdullah Aldahri*****
*****Radiology Technician , Health Monitoring Centers at King Abdulaziz Airport/ jeddah
Saeed Ahmed Attih Alhartomi******
****** Radiology Technician ,Al Leith General Hospital / Al Leith
Saud Ali Abbad Alqurashi*******
*******Radiological Technology , Al Leith General Hospital / Al Leith
Alaa Salem Omar Batayyah********
********Radiology Technician, Health Monitoring Centers at King Abdulaziz Airport/ jeddah
AHMED MUJIB SHANNAN ALZHRANI*********
*********Radiology Technician , Health Monitoring Centers at King Abdulaziz Airport/ Jeddah
FAHAD BERKY SETRULLAH ALSULAMI**********
**********Radiology Technician , Makkah,Comprehensive Medical Examination Center

***Abstract*:**

The current study aimed to examine the role of brain magnetic resonance imaging (MRI) in the early detection of brain and nerve diseases. Brain MRI is a safe and painless test that uses magnetic fields and radio waves to produce detailed images of the brain and brainstem that are clearer and more detailed than other methods. These detailed images allow doctors to accurately examine the head and detect diseases. Conventional MRI is able to detect neuronal axonal injury and blood products inside the skull within hours after the injury. MRI at SynaClinic opens new horizons in the diagnosis of diseases. This technology is one of the latest medical methods that enable doctors to obtain accurate and detailed images of the body's internal organs. Thanks to innovations and advanced technology, MRI contributes to the early detection of many diseases, which facilitates the development of effective treatment plans. It also helps reduce the need for unnecessary surgical procedures and enhances the quality of health care provided to patients.

Keywords: Magnetic Resonance -Brain - Early Detection - Nerve Diseases .

I. INTRODUCTION

The first MR images of a human brain were obtained in 1978 by two groups of researchers at EMI Laboratories led by Ian Robert Young and Hugh Clow.[1] In 1986, Charles L. Dumoulin and Howard R. Hart at General Electric developed MR angiography,[2] and Denis Le Bihan obtained the first images and later patented diffusion MRI.[3] In 1988, Arno Villringer and colleagues demonstrated that susceptibility contrast agents may be employed in perfusion MRI.[4] In 1990, Seiji Ogawa at AT&T Bell labs recognized that oxygen-depleted blood with dHb was attracted to a magnetic field, and discovered the technique that underlies Functional Magnetic Resonance Imaging (fMRI).[5]

Figure 1

A 'Jedi' helmet, on display at the Science Museum:Medicine:The Wellcome Galleries

In the early 1980s to the early 1990s, 'Jedi' helmets, inspired by the 'Return of the Jedi' Star Wars film, were sometimes worn by children in order to obtain good image quality.

The copper coils of the helmet were used as a radio aerial to detect the signals while the 'Jedi' association encouraged children to wear the helmets and not be frightened by the procedure. These helmets were no longer needed as MR scanners improved.

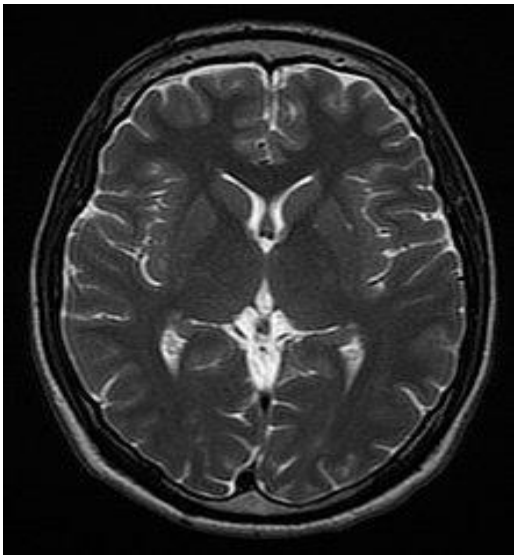
Magnetic Resonance Imaging of the Brain:

In the early 1990s, Peter Basser and Le Bihan, working at NIH, and Aaron Filler, Franklyn Howe, and colleagues developed diffusion tensor imaging (DTI).[6][7][8][9] Joseph Hajnal, Young and Graeme Bydder described the use of FLAIR pulse sequence to demonstrate high signal regions in normal white matter in 1992.[10] In the same year, John Detre, Alan P. Koretsky and coworkers developed arterial spin labeling.[11] In 1997, Jürgen R. Reichenbach, E. Mark Haacke and coworkers at Washington University in St. Louis developed Susceptibility weighted imaging.[12]

The first study of the human brain at 3.0 T was published in 1994,[13] and in 1998 at 8 T.[14] Studies of the human brain have been performed at 9.4 T (2006)[15] and up to 10.5 T (2019).[16]

Paul Lauterbur and Sir Peter Mansfield were awarded the 2003 Nobel Prize in Physiology or Medicine for their discoveries concerning MRI.

Figure2



This axial T2-weighted (CSF white) MR scan shows a normal brain at the level of the lateral ventricles.

The record for the highest spatial resolution of a whole intact brain (postmortem) is 100 microns, from Massachusetts General Hospital. The data was published in Scientific Data on 30 October 2019.[17][18]

Applications:

One advantage of MRI of the brain over computed tomography of the head is better tissue contrast,[19] and it has fewer artifacts than CT when viewing the brainstem. MRI is also superior for pituitary imaging.[20] It may however be less effective at identifying early cerebritis.[21]

In the case of a concussion, an MRI should be avoided unless there are progressive neurological symptoms, focal neurological findings or concern of skull fracture on exam.[22] In the analysis of a concussion, measurements of Fractional Anisotropy, Mean Diffusivity, Cerebral Blood Flow, and Global Connectivity can be taken to observe the pathophysiological mechanisms being made while in recovery.[23]

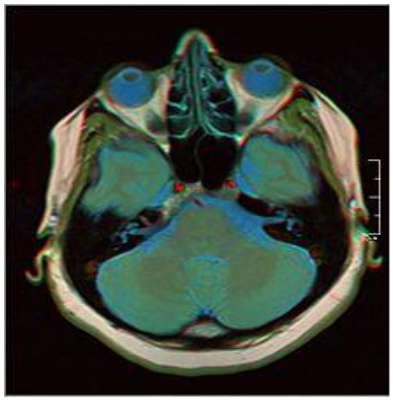
In analysis of the fetal brain, MRI provides more information about gyration than ultrasound.[24]

MRI is sensitive for the detection of brain abscess.[25]

A number of different imaging modalities or sequences can be used with imaging the nervous system:

- T1-weighted (T1W) images: Cerebrospinal fluid is dark. T1-weighted images are useful for visualizing normal anatomy.
- T2-weighted (T2W) images: CSF is light, but fat (and thus white matter) is darker than with T1. T2-weighted images are useful for visualizing pathology.[26]
- Diffusion-weighted images (DWI): DWI uses the diffusion of water molecules to generate contrast in MR images.
- Proton density (PD) images: CSF has a relatively high level of protons, making CSF appear bright. Gray matter is brighter than white matter.[27]

Figure3

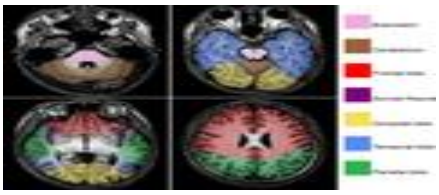


False color MRI by applying red to T1, green to PD and blue to T2.

- Fluid attenuation inversion recovery (FLAIR): useful for evaluation of white matter plaques near the ventricles.[28] It is useful in identifying demyelination.[29]

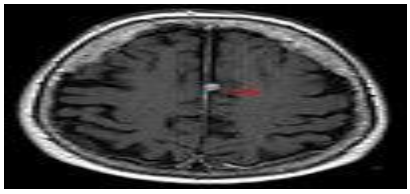
Gallery:

Figure4



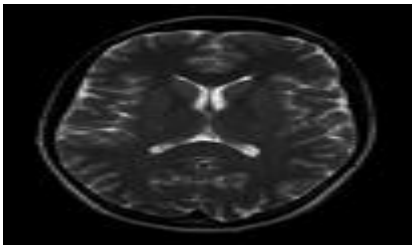
Brain regions on T1 MRI

Figure5



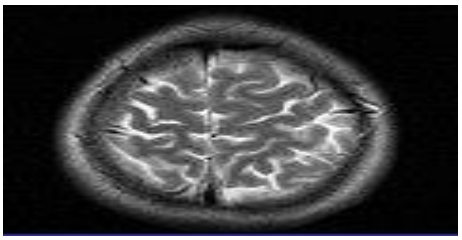
T1 (note CSF is dark) with contrast (arrow pointing to meningioma of the falx)

Figure6



Normal axial T2-weighted MR image of the brain

Figure7



MRI image of the surface of the brain.

Diagnostic Usage:

MRI of the brain and head has multiple diagnostic usages, including identifying aneurysms, strokes, tumors and other brain injury.[30] In many diseases, such as Parkinson's or Alzheimer's, MRI is useful to help differentially diagnose against other diseases.[31][32] On the topic of diagnosis, MRI data has been used with deep learning networks to identify brain tumors.[33]

Anatomy of the Spine :

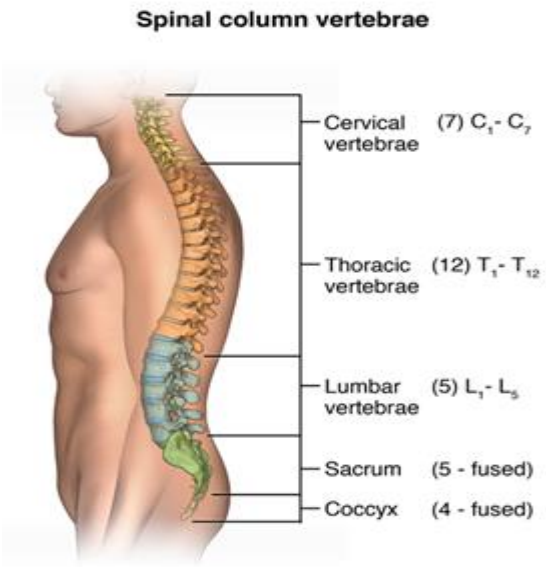
The spinal column, also called the vertebral or spinal canal, is made up of 33 vertebrae that are separated by spongy disks and classified into distinct areas.

- The cervical area consists of 7 vertebrae in the neck.
- The thoracic area consists of 12 vertebrae in the chest area.
- The lumbar area consists of 5 vertebrae in the lower back area.

- The sacrum has 5 small, fused vertebrae.
- The 4 coccygeal vertebrae fuse to form 1 bone, called the coccyx or tailbone.

The spinal cord, a major part of the central nervous system, is located in the vertebral canal and reaches from the base of the skull to the upper part of the lower back. The spinal cord is surrounded by the bones of the spine and a sac containing cerebrospinal fluid. The spinal cord carries sensory and movement signals to and from the brain, and controls many reflexes.

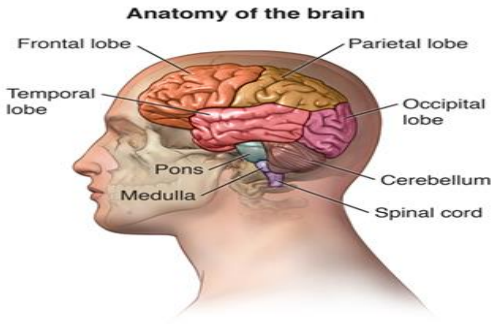
Figure8



Anatomy of the brain :

The central nervous system (CNS) consists of the brain and spinal cord. The brain is an important organ that controls thought, memory, emotion, touch, motor skills, vision, respirations, temperature, hunger, and every other process that regulates our body.

Figure9



The different parts of the brain:

The brain can be divided into the cerebrum, brainstem, and cerebellum:

- **Cerebrum.** The cerebrum (supratentorial or front of brain) is composed of the right and left hemispheres. Functions of the cerebrum include: initiation of movement, coordination of movement, body temperature, touch, vision, hearing, judgment, reasoning, problem solving, emotions, and learning.
- **Brainstem.** The brainstem (midline or middle of brain) includes the midbrain, the pons, and the medulla. Functions of this area include: movement of the eyes and mouth, relaying sensory messages (such as hot, pain, and loud), hunger, respirations, consciousness, cardiac function, body temperature, involuntary muscle movements, sneezing, coughing, vomiting, and swallowing.
- **Cerebellum.** The cerebellum (infratentorial or back of brain) is located at the back of the head. Its function is to coordinate voluntary muscle movements and to maintain posture, balance, and equilibrium.

More specifically, other parts of the brain include the following:

- **Pons.** A deep part of the brain, located in the brainstem, the pons contains many of the control areas for eye and face movements.
- **Medulla.** The lowest part of the brainstem, the medulla is the most vital part of the entire brain and contains important control centers for the heart and lungs.
- **Spinal cord.** A large bundle of nerve fibers located in the back that extends from the base of the brain to the lower back, the spinal cord carries messages to and from the brain and controls many reflexes.
- **Frontal lobe.** The largest section of the brain located in the front of the head, the frontal lobe is involved in personality characteristics and movement.
- **Parietal lobe.** The middle part of the brain, the parietal lobe helps a person to identify objects and understand spatial relationships (where one's body is compared to

objects around the person). The parietal lobe is also involved in interpreting pain and touch in the body.

- **Occipital lobe.** The occipital lobe is the back part of the brain that is involved with vision.
- **Temporal lobe.** The sides of the brain, these temporal lobes are involved in memory, speech, and sense of smell.

The reasons for an MRI of the brain:

MRI may be used to examine the brain and/or spinal cord for injuries or the presence of structural abnormalities or certain other conditions, such as:

- Tumors
- Abscesses
- Congenital abnormalities
- Aneurysms
- Venous malformations
- Hemorrhage, or bleeding into the brain or spinal cord
- Subdural hematoma (an area of bleeding just under the dura mater, or covering of the brain)
- Degenerative diseases, multiple sclerosis , hypoxic encephalopathy (dysfunction of the brain due to a lack of oxygen), or encephalomyelitis (inflammation or infection of the brain and/or spinal cord)
- Hydrocephalus , or fluid in the brain
- Herniation or degeneration of discs of the spinal cord
- Help plan surgeries on the spine, such as decompression of a pinched nerve or spinal fusion

MRI can also help to identify the specific location of a functional center of the brain (the specific part of the brain controlling a function, such as speech or memory) to assist in treatment of a condition of the brain.

There may be other reasons for your doctor to recommend MRI of the spine or brain.

Most brain-imaging research focuses on alcohol-dependent individuals recruited through treatment programs. However, the majority of people who meet the criteria for alcohol dependence never seek treatment for their condition (Cohen et al. 2007). Some treatment-naïve alcoholics also show brain alterations (Fein et al. 2002; Gazdzinski et al. 2008*a*), but their lifetime trajectory of alcohol use differs from treatment seekers (Fein and Landman 2005), suggesting yet another dimension of variability to be considered when designing studies of the effect of excessive alcohol consumption on the brain. Despite these challenges in conducting in vivo imaging studies of the consequences, studies generally are in agreement over the broad pattern of disruption observed and find that observations made in the living brain with MRI are consistent with a large literature of pathological data obtained by examining brains postmortem.

The following sections examine MRI evidence for brain abnormalities on both macrostructural and microstructural levels (using conventional MRI and diffusion tensor imaging[3] [DTI], respectively). Additional studies review the efficiency with which blood flow serves the activation of nerve cells (i.e., neurons) called upon when people perform experimental cognitive tasks (i.e., functional MRI [fMRI], which is described in the textbox on page 370). Cross-sectional studies (reviewed below) of the effects of excessive alcohol consumption on the brain conclude that although few regions of the brain appear entirely immune from the untoward consequences of alcoholism, the regions most at risk include the prefrontal cortex and subjacent white matter, cerebellar sites, and white matter structures and tracts, including the corpus callosum. Subsequent sections review evidence regarding the brain consequences of excessive alcohol consumption that appear to be reversible in the first weeks and months of sobriety and those that persist even with extended sobriety. The reader is referred elsewhere for fuller descriptions of the MRI methods and, quantification approaches, as well as artifactual considerations that limit the usefulness of brain-imaging data (Adalsteinsson et al. 2002; Hennig et al. 2003; Pfefferbaum et al. 2006*b*; Rosenbloom et al. 2003).

Structural Magnetic Resonance Imaging

Conventional structural magnetic resonance imaging (MRI) takes advantage of the fact that different tissue types in the brain contain different proportions of water, which influences their MRI-visible signal (see figure 1A). Gray matter is about 80 percent water and consists of nerve cells (i.e., neurons) and glial cells, which support neurons. White matter is about 70 percent water and consists of long fibers called axons that carry information between neurons. Cerebrospinal fluid (CSF) fills the spaces between the infoldings of the brain, the ventricular system in the brain, and the space surrounding the brain within the skull and is about 100 percent water. White matter is paler in color than gray matter because the axons are enwrapped in myelin, which is a system of cell bodies (i.e., oligodendrocytes) that wind around the axon and augment neural transmission. The axons form fiber tracts linking nearby and distant neurons across different brain regions (i.e., white matter tracts) (see figure 2). With structural MRI, researchers can identify differences in brain tissue types and structures by manipulating the way in which water protons are excited, yielding intensity differences between tissue types that allow researchers to map gross brain neuroanatomy (i.e., macrostructure). Intensity differences also are used to differentiate gray matter, white matter, and CSF. Volumes of these tissue types can then be measured in different regions of the brain. In addition, specific neuroanatomic structures, such as the corpus callosum, hippocampus, and basal ganglia, can be outlined and their volumes measured. MRI is a safe, noninvasive method to examine the structure of living

humans and animals and is powerful enough to detect changes in brain structure that can occur with alcohol sobriety (see figure 5).

Studies Comparing Alcoholics and Nonalcoholics:

Structural MRI Evidence for Alcohol's Effects on Brain Structures:

MRI studies that compare patients with chronic alcoholism to people without a history of excessive alcohol use typically find smaller volumes of gray matter (Cardenas et al. 2005; Chanraud et al. 2007; Fein et al. 2002; Gazdzinski et al. 2005*b*; Jernigan et al. 1991; Pfefferbaum et al. 1992) in the cerebral cortex, the folded outer layer of the brain. Gray matter differences are more marked in alcoholics who smoke than in those who do not smoke (Gazdzinski et al. 2005*b*). The volume of white matter lying beneath and beside cortical gray matter also is smaller in alcoholics than in nonalcoholics (Chanraud et al. 2007; Gazdzinski et al. 2005*b*; Pfefferbaum et al. 1992). Older alcoholics show greater gray and white matter volume deficits relative to age-matched control subjects than younger alcoholics, especially in the frontal lobes (Cardenas et al. 2005; Pfefferbaum et al. 1997), even when older alcoholics have consumed equivalent amounts of alcohol over their lifetime as younger alcoholics.

This age–alcoholism interaction suggests that as people age, their brains become more vulnerable to the effects of excessive alcohol consumption (Pfefferbaum et al. 1992). Studies of community samples of men without histories of alcohol dependence found that heavy drinking (about four drinks a day) was associated with significantly more age-related reduction in frontal lobe volume (Kubota et al. 2001) and showed a negative association between lifetime alcohol intake and gray matter volume in the frontal lobes relative to lower-alcohol–consuming counter-parts (Taki et al. 2006).

MRI of the cerebral cortex also shows that temporal lobe white matter volume deficits are prevalent in patients with a history of alcohol withdrawal seizures (Sullivan et al. 1996). Studies show that the greatest cortical shrinkage in alcoholism without concurrent disease or other comorbidities (i.e., uncomplicated alcoholism) occurs in the frontal lobes (Pfefferbaum et al. 1997), which subserve reasoning, working memory, and problem solving (Oscar-Berman and Marinkovic 2007). These findings are consistent with postmortem studies (Courville 1955; Harper and Kril 1993).

In addition, the cerebellum, or "little brain," which lies behind and beneath the cerebral cortex, also is adversely affected even in patients with uncomplicated alcoholism (Chanraud et al. 2007; Sullivan et al. 2000*a*). These in vivo findings are consistent with postmortem reports of shrinkage, prominent in large neurons in part of the cerebellum known as the anterior superior vermis (Harper 1998).

Traditionally, the cerebellum was thought to be mainly responsible for controlling motor behavior, including balance. Alcohol-related damage to this structure is presumed to be responsible for the truncal and lower-limb motor deficits that cause lack of coordination and are observed commonly in patients with Wernicke-Korsakoff Syndrome[4] (Victor et al. 1971). More recent studies on the role of the cerebellum and the extensive circuits linking it to subcortical and cortical regions have highlighted its **critical** role for higher-order functions classically associated with the frontal lobes (Schmahmann 1997). Damage to the central portion of the cerebellum (i.e., the vermis) from excessive alcohol consumption thus contributes not only to deficits of balance and gait in chronic alcoholics (Sullivan et al. 2000*a*, 2006) but also to impairment in functions such as problem solving and working memory (Desmond et al. 1998; Sullivan et al. 2003*a*).

Figure10

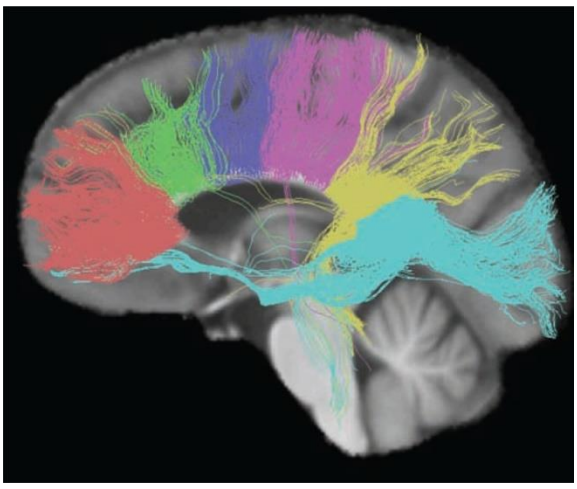
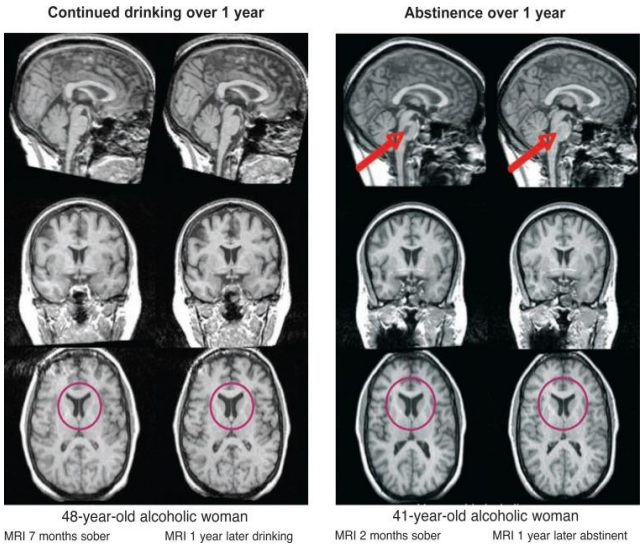


Figure11



Effect of abstinence. Brain images show the contrast between an alcoholic who continues to drink and one who maintains sobriety. For both cases, the images to the left were obtained after a period of sobriety and the images to the right were obtained 1 year later. In the lower panel for each woman, we see expansion of the lateral ventricles with continued drinking and reduction of the lateral ventricles with continued sobriety. In the upper panels we see that a lesion in the pons, clearly visible in the first image, has resolved after a year of sobriety.

Animal studies have revealed neurogenesis in the hippocampus in long-abstinent animals (Nixon and Crews 2004). Although no equivalent evidence currently is available in humans, one longitudinal MRI study (Cardenas et al. 2007) reported increased temporal lobe volume and MR spectroscopic[6] studies have shown improved neuronal integrity in abstinent alcoholics (Durazzo et al. 2006).

In studies of extended sobriety (i.e., 5 years), research focuses on comparing those who maintained sobriety with those who resumed drinking (Muuronen et al. 1989; Pfefferbaum et al. 1998). Long-term prolonged sobriety was associated with improvement or stabilization of measures of brain tissue volume, whereas return to drinking was associated with increased ventricular volume. In addition, among those who continued drinking, cortical gray matter loss over the follow-up period, especially in the frontal lobes, was associated with the degree of excessive drinking in retested alcoholics (Pfefferbaum et al. 1998). Several factors may diminish the likelihood of recovery of brain structure with sobriety—such as older age, heavier alcohol consumption, concurrent hepatic disease, history of withdrawal seizures, malnutrition, and concurrent smoking. Unfortunately, few studies to date have obtained longitudinal data on large enough samples to model these factors effectively, although one study (Yeh et al. 2007) demonstrated that greater smoking and drinking severity before abstinence was associated with greater reduction of ventricular volume during abstinence. Investigators have limited control over whether participants in longitudinal studies maintain abstinence or continue drinking. By contrast, studies of animals, reviewed below, give researchers control over the outcomes of abstinence and relapse.

Abstinence and Cognitive Improvements in Humans:

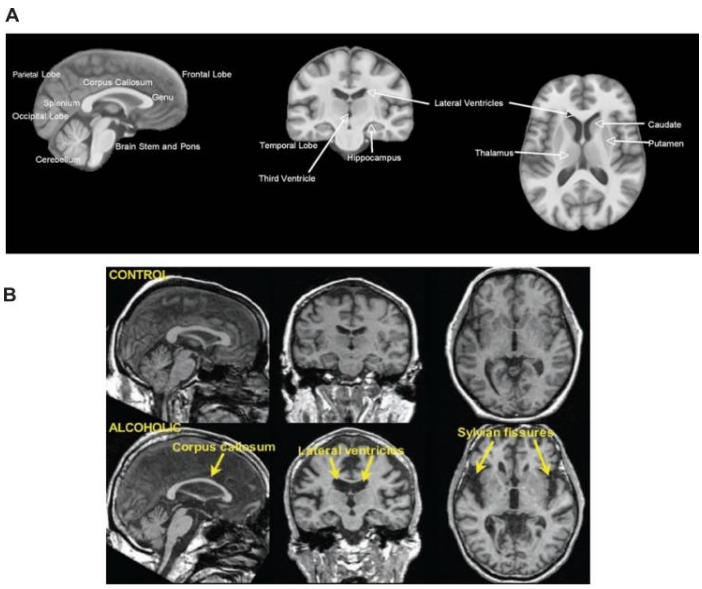
A growing number of longitudinal neuropsychological studies report significantly better scores on tests of working memory, visuospatial abilities, and gait and balance with abstinence from alcohol. Some components of these functional domains recover faster (Rosenbloom et al. 2004) or more fully than others (e.g., Becker et al. 1983; Brandt et al. 1983; Mann et al. 1999; Nixon and Glenn 1995; Parsons et al. 1987; Sullivan et al. 2000*b*), but at least a measurable degree of recovery typically accompanies prolonged sobriety, suggesting that the changes observed with neuroimaging have functional consequences.

Functional Magnetic Resonance Imaging:

The magnetic resonance imaging (MRI) and diffusion tensor imaging (DTI) techniques described above each provide a static representation of the brain. By contrast, functional MRI (fMRI) exploits the MRI-visible signal contrast between oxygenated (higher signal) and deoxygenated (lower signal) hemoglobin as it flows through small blood vessels in given brain regions. Neural activity while performing a cognitive, motor, or sensory task increases the ratio of oxygenated to deoxygenated hemoglobin in the blood of neighboring vasculture and enhances the MR signal. This blood oxygen level– dependent (BOLD) contrast mechanism does not directly measure blood flow or neuronal activity but rather the small, rapid changes in the blood's paramagnetic properties (related to unpaired electrons in the blood) that can be imaged by rapid sampling over the spatial domain (Logothetis and Pfeuffer 2004).

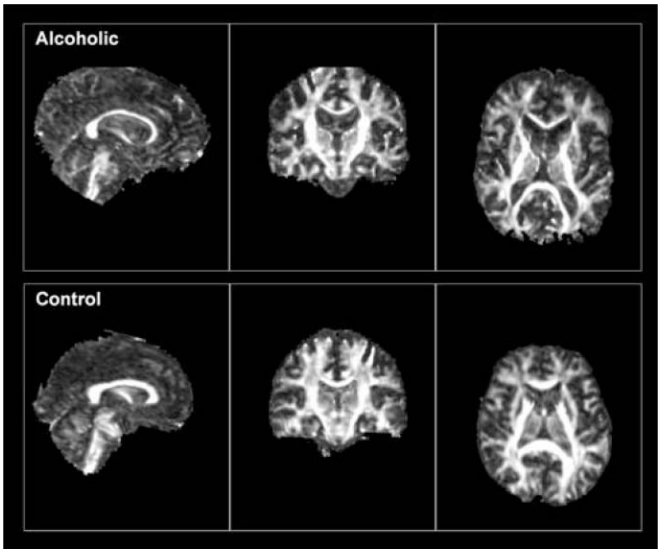
Changes in levels of oxygenated hemoglobin in blood vessels, the hemodynamic response that occurs in response to experimental manipulations, the affect local homogeneity of an MR signal. The BOLD effect is localized by measuring the difference between oxygenation at the time a specific task is completed and at a rest period or another (control) task. The regions of the brain showing the greatest difference between active and contrast conditions are believed to be those most involved in performing the operation under investigation (Hennig et al. 2003; Toma and Nakai 2002). Contrasts between groups (e.g., alcoholics and controls) further illustrate regions of the brain where one group shows more activation while performing a specific task than the other (figure 4). Further technical details about fMRI can be found in specialized reviews (Adalsteinsson et al. 2002; Buckner and Logan 2001; Buxton 2002; Friston 2005).

Figure 12



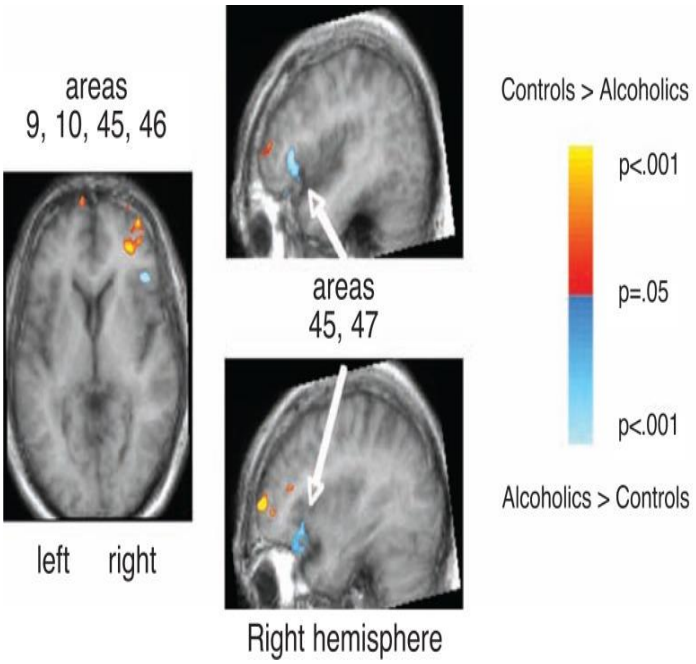
A) Standardized magnetic resonance imaging (MRI) of the brain viewed from the side, sagittal (left); back, coronal (middle); and above, axial (right). The dark areas represent fluid, white represents white matter, and shades of gray represent different gray matter areas and structures. Specific cortical regions and subcortical structures are labeled. **B)** MRI scans from a 53-year-old control man (upper) and a 53-year-old alcoholic man (lower) from the same views as shown above. Note the enlargement of the lateral ventricles and sulci, reduced cortical tissue, and skinnier corpus callosum in the alcoholic compared with the control.

Figure 13



Images from sagittal (left), coronal (center), and axial (right) views of a 57-year-old alcoholic man (upper panel) and a 54-year-old control man (lower panel) displaying values for fractional anistrophy (FA) and illustrating clearly the white matter architecture of the brain. Note the more robust appearing white matter structures in the control than the alcoholic. The sagittal view highlights the corpus callosum and the pons and brain stem structures. The coronal view illustrates how the corpus callosum (above the ventricles) links left and right hemispheres. The axial view illustrates the genu and splenium of the corpus callosum.

Figure 14



The results of a functional magnetic resonance imaging (fMRI) study in which alcoholics and control subjects performed a spatial location task while lying in the MR scanner. Three views of the brain illustrate the regions where alcoholics showed more (blue) or less (red) activation than control subjects when judging whether a dot on a slide was in the center, compared with a rest period (Pfefferbaum et al. 2001). The control subjects showed more activation in prefrontal areas (Brodmann's areas 9, 10, 45, and 46), whereas the alcoholics showed more activation in inferior and posterior frontal locations (Brodmann's areas 45 and 47) in the right hemisphere.

Role in Early Detection of Brain and Nerve Diseases:

Approximately one out of three people around the globe are affected by some type of neurological disorder. You may not know you have a neurological disorder until symptoms become so severe it disrupts your lifestyle. Early detection can provide numerous benefits to help improve overall quality of life and reduce these disruptive symptoms. Here are three main reasons why early detection is important for neurological disorders.

Prevent and Minimize Neurological Impairments:

Early detection of neurological disorders can help prevent and minimize long-term impairments for individuals. Common symptoms of these types of disorders can include headaches, seizures, dementia, and dysfunctions with motor skills or the nervous system. Advances in medical research have been able to detect biomarkers and other traits for specific neurological disorders to help make early detection more accurate.

These impairments can be treated effectively by receiving a diagnosis early so some symptoms cannot worsen over time. See a neurologist immediately if you are experiencing chronic pain, dizziness, numbness, or memory problems.

Receive the Right Treatment:

According to research, more than 600 neurological disorders have been identified. These disorders often have similar symptoms and it can be difficult to receive an accurate diagnosis without early detection testing. There are many types of diagnostic tests a neurologist can perform to determine the root cause of any disruptive symptoms. Early detection can help ensure an individual receives the right treatment for these symptoms to live a happier and healthier life.

During a neurological exam, a specialist may review your medical history and perform certain tests. These tests are designed to examine your nervous system for any issues with your balance, motor skills, coordination or mental state. The neurologist will recommend the best treatment plan for your condition based on the results.

Lower Medical Costs:

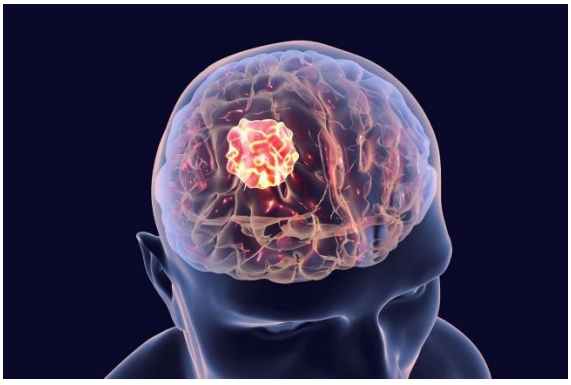
Early detection can help lower medical costs over time for individuals with neurological disorders. Research studies have concluded that early detection can slow disease progression and the risk of ensuing disabilities for certain disorders. Routine health screening and early lifestyle modifications can slow the need for expensive surgeries, medications or lengthy hospital stays. Without an accurate diagnosis in early stages, an individual could be directed to services and treatments that fail to be beneficial in reducing symptoms.

Individuals may avoid early screenings because of the cost of screenings. However, many individuals who are struggling financially may be able to receive these screenings at little to no charge. By taking advantage of available financial programs for early detection screening, you can minimize the many economic risks involved with the progression of neurological disorders.

Specialized Treatment for Neurological Disorders in Arizona:

Advancements in early detection for neurological disorders are becoming more beneficial for individuals to improve daily function. If you believe you may be struggling with symptoms, it is crucial to see an experienced neurologist immediately. Foothills Neurology specializes in early detection and treatment for individuals in Phoenix and Scottsdale, Arizona. Advanced diagnostics combined with comprehensive treatment can help ease your pain and suffering. Schedule an appointment for early detection testing today.

Figure15



Detecting brain tumors at an early stage is crucial for successful treatment and improved patient outcomes. In this blog, we will delve into the significance of early detection in brain tumor cases, exploring the various screening and diagnostic methods available. By understanding the importance of early detection, individuals can be empowered to seek timely medical attention, leading to better treatment options and increased

chances of recovery. In this context, we will also highlight the expertise of Dr. Vivek Bonde and his Brain and Spine Clinic, where patients can receive specialized care and comprehensive treatment for brain tumors.

Understanding Brain Tumors:

To comprehend the importance of early detection, it is essential to first understand what brain tumors are and how they can affect individuals. Brain tumors are abnormal growths in the brain or surrounding tissues that can be cancerous (malignant) or non-cancerous (benign). These tumors can arise from different cells and can be primary, originating within the brain, or secondary, spreading from other parts of the body.

Signs and Symptoms of Brain Tumors:

Identifying the signs and symptoms of brain tumors is crucial for early detection. Common symptoms may include persistent headaches, seizures, changes in vision, difficulty speaking, cognitive changes, and unexplained nausea or vomiting. However, it is important to note that these symptoms can vary depending on the tumor's size, location, and rate of growth. Early detection requires awareness of these symptoms and prompt medical attention if they persist or worsen.

Screening and Diagnostic Techniques:

A. Physical and Neurological Examinations:

The initial step in brain tumor detection involves a physical examination to assess overall health and neurological function. Neurological examinations help evaluate reflexes, muscle strength, coordination, and sensory responses.

B. Imaging Techniques:

Magnetic Resonance Imaging (MRI): MRI scans provide detailed images of the brain and help identify abnormalities, including tumors. Contrast-enhanced MRI with Gadolinium can enhance the visibility of brain tumors.

Computed Tomography (CT) Scan: CT scans utilize X-rays to produce cross-sectional images of the brain, aiding in tumor identification and evaluation.

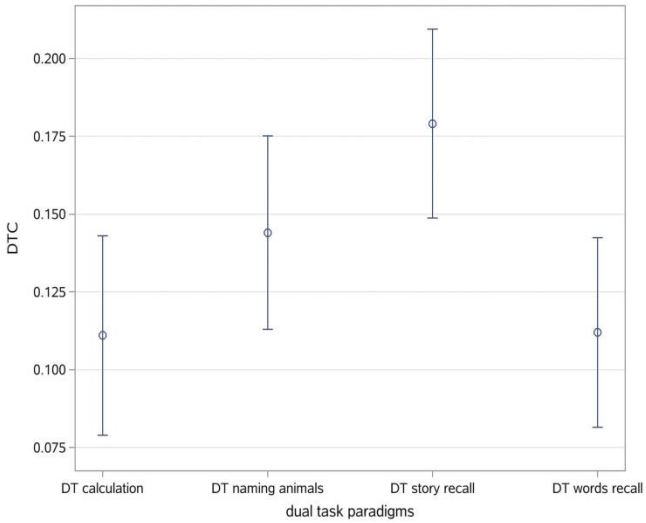
C. Biopsy:

A biopsy involves the removal and analysis of a small sample of brain tissue. It helps determine the tumor type, grade, and appropriate treatment plan. Stereotactic biopsy and open surgical biopsy are common approaches.

D. Cerebrospinal Fluid Examination:

In some cases, a lumbar puncture or "spinal tap" is performed to analyze cerebrospinal fluid for tumor markers or abnormal cells, especially when metastasis is suspected.

Figure16



Benefits of Early Detection:

Early detection of brain tumors offers several significant advantages:

A. Better Treatment Options- Timely diagnosis allows doctors to explore a range of treatment options, including surgery, radiation therapy, chemotherapy, targeted therapies, and immunotherapy. Early-stage tumors are generally more treatable and may not require aggressive interventions.

B. Improved Prognosis- Early detection often leads to better outcomes, as smaller tumors are typically associated with a higher chance of complete removal and improved overall survival rates. Early treatment can also prevent the tumor from causing further damage to critical brain structures.

C. Reduced Risk of Complications- Early detection enables prompt intervention, minimizing the risk of complications such as seizures, neurological deficits, and cognitive impairments. Treatment at an early stage can help prevent or manage these complications effectively.

D. Psychological Support- Early detection allows patients and their families to access necessary psychological and emotional support services, enabling them to cope with the diagnosis and treatment process more effectively. Early awareness also allows

patients to connect with support groups and engage in proactive discussions with healthcare professionals.

The Role of Dr. Vivek Bonde and His Brain and Spine Clinic:

When it comes to brain tumor screening and diagnosis, seeking the expertise of a specialist like Dr. Vivek Bonde and his Brain and Spine Clinic can make a significant difference. Dr. Bonde is renowned for his extensive experience in neurosurgery and his specialization in brain and spine conditions. His clinic is equipped with state-of-the-art technology and a dedicated team of medical professionals who provide personalized and comprehensive care to patients.

At Dr. Bonde's clinic, patients can expect:

A. Expert Diagnosis: Dr. Bonde and his team employ the latest diagnostic techniques, including advanced imaging technologies, to accurately identify and characterize brain tumors. Their expertise ensures accurate diagnosis and appropriate treatment planning.

B. Multidisciplinary Approach: Dr. Bonde recognizes the complexity of brain tumors and the need for a multidisciplinary approach. He collaborates with a team of specialists, including neurologists, oncologists, radiologists, and pathologists, to develop customized treatment plans tailored to each patient's specific needs.

C. Cutting-Edge Treatments: Dr. Bonde stays updated with the latest advancements in brain tumor treatments. His clinic offers a wide range of innovative treatment options, including minimally invasive surgery, targeted therapies, immunotherapy, and access to clinical trials. This ensures that patients receive the most advanced and effective treatments available.

D. Compassionate Care: Dr. Bonde and his team prioritize the well-being and comfort of their patients. They provide comprehensive support throughout the diagnostic and treatment journey, offering emotional support, counseling services, and guidance to help patients and their families navigate the challenges associated with brain tumors.

Summary:

Early detection of brain tumors plays a vital role in improving patient outcomes and overall prognosis. By recognizing the signs and symptoms, and promptly seeking medical attention, individuals can ensure timely diagnosis and access to a range of treatment options. Dr. Vivek Bonde and his Brain and Spine Clinic are dedicated to providing specialized care for brain tumors, offering state-of-the-art diagnostic techniques, advanced treatments, and compassionate support. With Dr. Bonde's expertise and the comprehensive services available at his clinic, patients can receive the highest standard of care, leading to improved chances of successful treatment and enhanced quality of life. If you suspect a brain tumor or have concerns, do not hesitate to consult Dr. Vivek Bonde and his team for expert guidance and personalized care.

Figure17

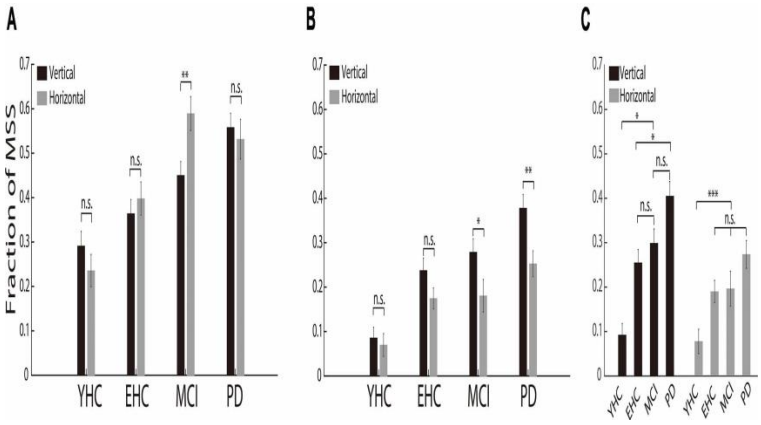
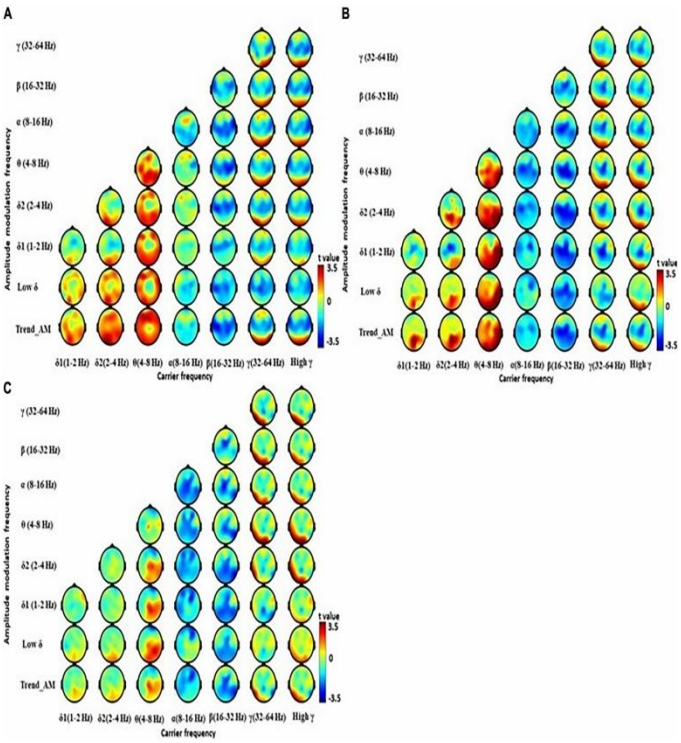


Figure18



Neurological disorders are conditions that affect the nervous system, including the brain, spinal cord, and nerves. These disorders can significantly impact a person's daily functioning and quality of life, making early detection crucial for effective treatment and management. Continue reading to learn more from the Atlanta Neuroscience Institute about why early detection is so important.

Figure19

Better Outcomes

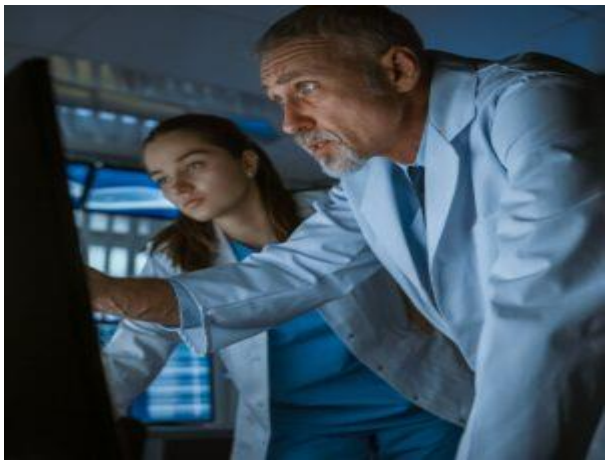
One of the most critical reasons for early detection of neurological disorders is the potential for better treatment outcomes. Many neurological disorders, such as Parkinson's disease, Alzheimer's disease, and Multiple Sclerosis, have no cure. The available treatments can only manage symptoms and slow down the progression of the disease. Therefore, the earlier the disease is diagnosed, the sooner treatment can begin, which may help delay or minimize the severity of symptoms.

Figure20

Reduced Risk Of Complications:

Some neurological disorders can lead to complications if left untreated. For instance, untreated epilepsy can result in seizures that can cause injuries and even death. Early detection and treatment can prevent such complications and improve the overall health of individuals with neurological disorders.

Figure21



Identify Underlying Causes:

Many neurological disorders have a complex and multifactorial nature, with a combination of genetic and environmental factors contributing to their development. Identifying these underlying causes can help healthcare professionals develop personalized treatment plans that target the specific factors contributing to the disorder. This individualized approach can lead to more effective treatment and management of the disorder.

Figure22

Early Access To Support:

Early detection can also provide individuals and their families with access to support and resources that can help them cope with the disorder. This may include education about the disorder, support groups, and access to clinical trials and specialized treatment. These resources can be crucial in managing the disorder and improving the overall well-being of individuals and their families.

References:

VAUGHAN T; DELABARRE L; SNYDER C; TIAN J; AKGUN C; SHRIVASTAVA D; LIU W; OLSON C; ADRIANY G; ET AL. (DECEMBER 2006). "9.4T HUMAN MRI: PRELIMINARY RESULTS". MAGN RESON MED. 56 (6): 1274–82. DOI:10.1002/MRM.21073. PMC 4406343. PMID 17075852.

SADEGHI-TARAKAMEH, ALIREZA; DELABARRE, LANCE; LAGORE, RUSSELL L.; TORRADO-CARVAJAL, ANGEL; WU, XIAOPING; GRANT, ANDREA; ADRIANY, GREGOR; METZGER, GREGORY J.; VAN DE MOORTELE, PIERRE-FRANCOIS; UGURBIL, KAMIL; ATALAR, ERGIN (2019-11-21). "IN VIVO HUMAN HEAD MRI AT 10.5T: A RADIOFREQUENCY SAFETY STUDY AND PRELIMINARY IMAGING RESULTS". MAGNETIC RESONANCE IN MEDICINE. 84 (1): 484–496. DOI:10.1002/MRM.28093. HDL:11693/53263. ISSN 0740-3194. PMC 7695227. PMID 31751499. S2CID 208226414.

"100-HOUR-LONG MRI OF HUMAN BRAIN PRODUCES MOST DETAILED 3D IMAGES YET". 10 JULY 2019.

"TEAM PUBLISHES ON HIGHEST RESOLUTION BRAIN MRI SCAN".

EBEL KD, BENZ-BOHM G (1999). DIFFERENTIAL DIAGNOSIS IN PEDIATRIC RADIOLOGY. THIEME. PP. 538–. ISBN 978-3-13-108131-5. RETRIEVED 18 JULY 2011.

BRADLEY WG, BRANT-ZAWADZKI M, CAMBRAY-FORKER J (2001-01-15). MRI OF THE BRAIN. SURENDRA KUMAR. ISBN 978-0-7817-2568-2. RETRIEVED 24 JULY 2011.

ROOS KL, TUNKEL AR (2010). BACTERIAL INFECTIONS OF THE CENTRAL NERVOUS SYSTEM. ELSEVIER HEALTH SCIENCES. PP. 69–. ISBN 978-0-444-52015-9. RETRIEVED 18 JULY 2011.

AMERICAN MEDICAL SOCIETY FOR SPORTS MEDICINE (24 APRIL 2014), "FIVE THINGS PHYSICIANS AND PATIENTS SHOULD QUESTION", CHOOSING WISELY: AN INITIATIVE OF THE ABIM FOUNDATION, AMERICAN MEDICAL SOCIETY FOR SPORTS MEDICINE, RETRIEVED 29 JULY 2014

CHURCHILL NATHAN W., HUTCHISON MICHAEL G., RICHARDS DOUG, LEUNG GENERAL, GRAHAM SIMON J., SCHWEIZER TOM A. (2017). "THE FIRST WEEK AFTER CONCUSSION: BLOOD FLOW, BRAIN FUNCTION AND WHITE MATTER MICROSTRUCTURE". NEUROIMAGE: CLINICAL. 14: 480–489. DOI:10.1016/J.NICL.2017.02.015. PMC 5334547. PMID 28280686.

GAREL C (2004). MRI OF THE FETAL BRAIN: NORMAL DEVELOPMENT AND CEREBRAL PATHOLOGIES. SPRINGER. ISBN 978-3-540-40747-8. RETRIEVED 24 JULY 2011.

RATH, TANYA J.; HUGHES, MARION; ARABI, MOHAMMAD; SHAH, GAURANG V. (2012). "IMAGING OF CEREBRITIS, ENCEPHALITIS, AND BRAIN ABSCESS". NEUROIMAGING CLINICS OF NORTH AMERICA. 22 (4). ELSEVIER BV: 585–607. DOI:10.1016/J.NIC.2012.04.002. ISSN 1052-5149. PMID 23122258.

BUTLER P, MITCHELL AW, ELLIS H (2007-11-19). APPLIED RADIOLOGICAL ANATOMY FOR MEDICAL STUDENTS. CAMBRIDGE UNIVERSITY PRESS. PP. 12–. ISBN 978-0-521-81939-8. RETRIEVED 18 JULY 2011.

TOFTS, PAUL (2005-09-01). QUANTITATIVE MRI OF THE BRAIN: MEASURING CHANGES CAUSED BY DISEASE. JOHN WILEY AND SONS. PP. 86–. ISBN 978-0-470-86949-9. RETRIEVED 18 JULY 2011.

CHOWDHURY R, WILSON I, ROFE C, LLOYD-JONES G (2010-04-19). RADIOLOGY AT A GLANCE. JOHN WILEY AND SONS. PP. 95–. ISBN 978-1-4051-9220-0. RETRIEVED 18 JULY 2011.

GRANACHER RP (2007-12-20). TRAUMATIC BRAIN INJURY: METHODS FOR CLINICAL AND FORENSIC NEUROPSYCHIATRIC ASSESSMENT. CRC PRESS. PP. 247–. ISBN 978-0-8493-8138-6. RETRIEVED 18 JULY 2011.

"MRI - MAYO CLINIC". WWW.MAYOCLINIC.ORG. RETRIEVED 2023-12-22.

HEIM, BEATRICE; KRISMER, FLORIAN; DE MARZI, ROBERTO; SEPPI, KLAUS (2017-08-01). "MAGNETIC RESONANCE IMAGING FOR THE DIAGNOSIS OF PARKINSON'S DISEASE". JOURNAL OF NEURAL TRANSMISSION. 124 (8): 915–964. DOI:10.1007/S00702-017-1717-8. ISSN 1435-1463. PMC 5514207. PMID 28378231.

FRISONI, GIOVANNI B.; FOX, NICK C.; JACK, CLIFFORD R.; SCHELTENS, PHILIP; THOMPSON, PAUL M. (FEBRUARY 2010). "THE CLINICAL USE OF STRUCTURAL MRI IN ALZHEIMER DISEASE". NATURE REVIEWS NEUROLOGY. 6 (2): 67–77. DOI:10.1038/NRNEUROL.2009.215. ISSN 1759-4766. PMC 2938772.

SEGATO, ALICE; MARZULLO, ALDO; CALIMERI, FRANCESCO; DE MOMI, ELENA (2020-12-01). "ARTIFICIAL INTELLIGENCE FOR BRAIN DISEASES: A SYSTEMATIC REVIEW". APL BIOENGINEERING. 4 (4). AIP PUBLISHING: 041503. DOI:10.1063/5.0011697. ISSN 2473-2877. PMC 7556883. PMID 33094213.

ADALSTEINSSON E, SULLIVAN EV, PFEFFERBAUM A. BIOCHEMICAL, FUNCTIONAL AND MICROSTRUCTURAL MAGNETIC RESONANCE IMAGING (MRI) IN: LIU Y, LOVINGER DM, EDITORS. METHODS IN ALCOHOL-RELATED NEUROSCIENCE RESEARCH. BOCA RATON, FL: CRC PRESS; 2002. PP. 345–372. [GOOGLE SCHOLAR]

BUCKNER RL, LOGAN JM. FUNCTIONAL NEUROIMAGING METHODS: PET AND FMRI. IN: CABEZA R, KINGSTONE A, EDITORS. HANDBOOK OF FUNCTIONAL NEUROIMAGING OF COGNITION. CAMBRIDGE, MA: MIT PRESS; 2001. PP. 27–48. [GOOGLE SCHOLAR]

BUXTON RB. INTRODUCTION TO FUNCTIONAL MAGNETIC RESONANCE IMAGING: PRINCIPLES & TECHNIQUES. CAMBRIDGE, UK: CAMBRIDGE UNIVERSITY PRESS; 2002. [GOOGLE SCHOLAR]

FRISTON KJ. MODELS OF BRAIN FUNCTION IN NEUROIMAGING. ANNUAL REVIEW OF PSYCHOLOGY. 2005;56:57–87. DOI: 10.1146/ANNUREV.PSYCH.56.091103.070311. [DOI] [PUBMED] [GOOGLE SCHOLAR]

HENNIG J, SPECK O, KOCH MA, WEILLER C. FUNCTIONAL MAGNETIC RESONANCE IMAGING: A REVIEW OF METHODOLOGICAL ASPECTS AND CLINICAL APPLICATIONS. JOURNAL OF MAGNETIC RESONANCE IMAGING. 2003;18:1–15. DOI: 10.1002/JMRI.10330. [DOI] [PUBMED] [GOOGLE SCHOLAR]

LOGOTHETIS NK, PFEUFFER J. ON THE NATURE OF THE BOLD FMRI CONTRAST MECHANISM. MAGNETIC RESONANCE IMAGING. 2004;22:1517–1531. DOI: 10.1016/J.MRI.2004.10.018. [DOI] [PUBMED] [GOOGLE SCHOLAR]

TOMA K, NAKAI T. FUNCTIONAL MRI IN HUMAN MOTOR CONTROL STUDIES AND CLINICAL APPLICATIONS. MAGNETIC RESONANCE IN MEDICAL SCIENCE. 2002;1:109–120. DOI: 10.2463/MRMS.1.109. [DOI] [PUBMED] [GOOGLE SCHOLAR]