REVIEW PAPER, REVIEW ARTICLE (PREGLEDNI RAD)

7T MRI versus 3T MRI in brain diseases diagnosis

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Abstract

MRI has greatly improved diagnostic medicine in recent decades. By constantly changing and improving technological aspects, MRI is becoming an increasingly sophisticated and refined method. By constantly tending to increase the used magnetic field, the spatial resolution and contrast increase due to the increase in SNR. These factors enable a detailed and clear presentation of previously invisible pathologies, especially pathologies in the brain. The aim of this work is to compare the importance of the technological features of 3T and 7T MRI in brain imaging and to distinguish their advantages and disadvantages. 3T MRI is used in daily clinical practice worldwide. One of the basic questions that scientists deal with in most research is the importance of 7T compared to 3T in the presentation of various brain pathologies. It was found that the improved technological characteristics of the device with a higher magnetic field affect the better representation of epileptogenic lesions and lesions that are specific for multiple sclerosis. In addition, a better representation of the internal structure of the tumor, a better representation of aneurysms and microbleeds and changes that are characteristic of neurodegenerative diseases such as Alzheimer's disease and Parkinson's disease is obtained. It was of great importance to determine whether there is superiority of 7T in these pathologies to determine all the available possibilities, advantages and disadvantages because these are diseases that have an increasing prevalence in the population. On the 7T MRI, there are also technological problems that can lead to poor recording quality, for which various solutions are proposed and investigated. After reviewing numerous studies, it was determined that 3T MRI is a quality device for current use, but 7T has the ability to display details and can provide a higher quality image and greater diagnostic precision and can be of great importance, especially in certain patients where 3T is not detailed enough. It should be noted that 7T MRI still needs to be researched, but it is safe for human use and represents the future of diagnostic medicine.

Keywords: brain, magnetic field, 3T MR, 7T MR

Abbreviations and acronyms: FA (Flip angle), FDA (Food and Drug Administration), FLAIR (Fluid attenuation inverse recovery), FSE (Fast spin echo), GRE (gradient-echo), IR (Inversion recovery), ISMRM (International Society for Magnetic Resonance in Medicine), MRI (Magnetic resonance imaging), RF (Radiofrequency), SE (spin-echo), STIR (Short taut inverse recovery), SWI (Susceptibility-weighted imaging), TE (Time to echo), TOF (Time of flight), TR (Time repetition), TSE (Turbo spin echo)

Introduction

Radiology is a science without which it is impossible to imagine modern medicine today. It enables early diagnosis, and sometimes therapy, of seriously ill patients. The daily use of radiological modalities enables doctors to make faster and more accurate diagnoses, and overall helps to improve the quality patients' lives. Magnetic resonance imaging (MRI) is often called the greatest advance in diagnostic medicine since the discovery of X-rays in 1895. MRI has become one of the most widely used tools in radiology that can be applied to any part of the body. The human body is shown on MRI in all three planes: sagittal, coronary and transverse. A method by which, based on the principle of tomography, we obtain high-resolution cross-sections of the human body [1, 2]. MRI finds its use in the imaging of many organic systems, and since its development it has been important in the imaging of the brain.

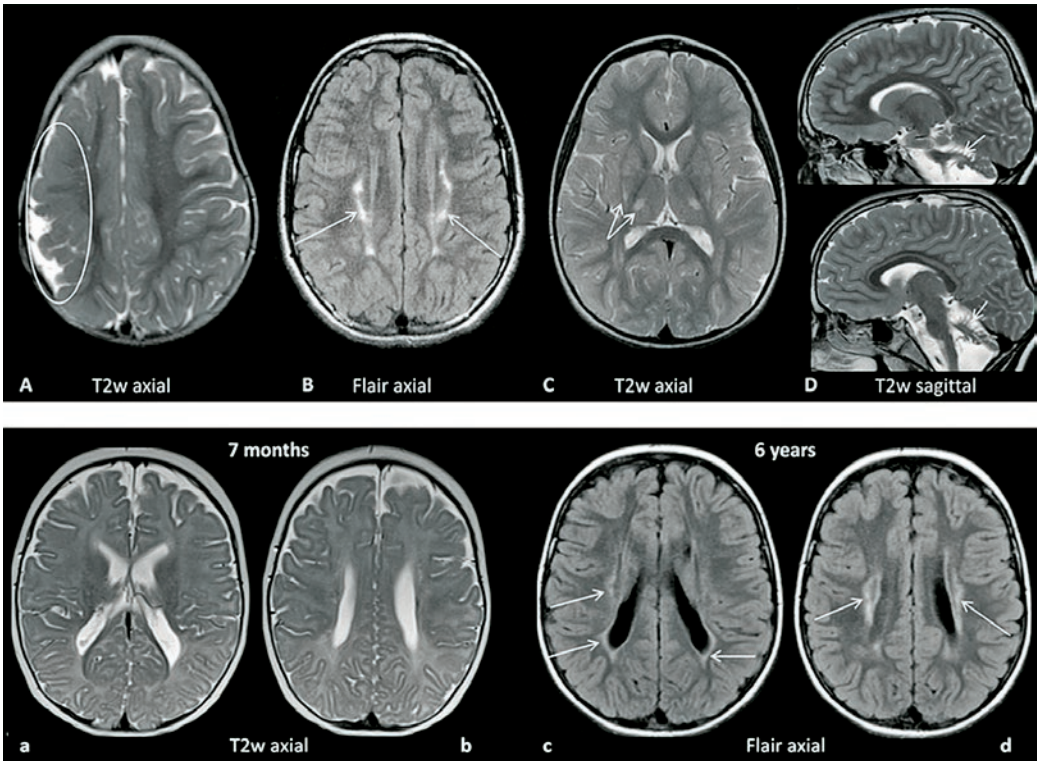

Figure 1. Example of different sequences in brain imaging
Source: https://www.researchgate.net/figure/Upper-row-Examples-for-MRI-patterns-A-Maldevelopment-frontoparietal-polymicrogyria_fig1_349155368

Use of MRI in brain imaging

One of the tests that are performed every day around the world in large numbers is the brain MRI. MRI is chosen as the brain imaging modality because it does not use ionizing radiation and has the ability to show detailed structures inside the brain. It is currently considered the most sensitive method for imaging the central nervous system [3]. An MRI of the brain will show the entire brain, blood vessels, skull and facial bones, nerves and very fine structures of the inner ear and eye. In addition, the soft tissues and muscles surrounding the skull can be observed. Neurologists and doctors of other specialties who have the authority to request an MRI scan do so for various indications. Just some of the indications are clots, bleeding, aneurysms, tumors, infections. MRI can be used to diagnose diseases such as epilepsy or multiple sclerosis, but it can also serve as a modality by which the doctor will monitor the progress and effect of therapy in such and similar pathological conditions [3].

Basic pulse sequences

Pulse sequences are classified into spin-echo (SE) and gradient-echo (GRE) groups based on the type of echo. SE sequences record the echo after the tissue is excited with a 90° RF pulse and a 180° pulse that refocuses the transverse magnetization. Time repetition (TR) and Time to echo (TE) parameters are important for contrast in SE sequences. FSE and TSE, fast spin echo and turbo spin echo are accelerated versions of SE sequences, while Fluid attenuation inverse recovery (FLAIR) and Short taut inverse recovery (STIR) sequences are short scan versions. Inversion sequences, Inversion recovery (IR) are significant for tissue suppression based on T1 relaxation. Inversion time, Time to invert (TI) determines the time between the emission center of the inverse pulse and the RF pulse. FLAIR sequences are crucial for imaging the brain, making the cerebrospinal fluid hypointense and allowing easier observation of pathology (Figure 1). GRE sequences detect the signal generated after tissue excitation with a 90° pulse and a series of gradient pulses. The contrast in GRE recordings is determined by the Flip angle (FA) and TE parameters. GRE sequences are important in clinical applications because they are necessary for the preparation of localizers or topograms before each examination [4-7].

7T MRI

Since the beginning of the development of MRI and its utilization in daily clinical use, there has been an effort to improve the device and improve the quality of the image. MRI of magnetic field strength 3T in most countries of the world, including Croatia, is in active clinical use. 7T MRI, due to the higher strength of the magnetic field and shorter scanning time, is of great importance in brain imaging because it enables a better and more detailed view of lesions, such as lesions typical of multiple sclerosis, and the internal structure of brain tumors, such as glioblastoma [8]. On October 12, 2017, the Food and Drug Administration (FDA) approved the clinical use of the first 7T MRI, stating that it has been proven that the image quality is higher due to the strong magnetic field and that the strong field enables a better and detailed visualization of pathologies that can help in early diagnosis and

	T1 MP2RAGE 3D		T2 TSE 2D		FLAIR TSE 2D		T2* GRE		FLAIR SPACE 3D		DWI Single Shot	
	3T	7T	3T	7T	3T	7T	3T	7T	3T	7T	3T	7T
Voxel dimensions	0.9 x 0.9	0.8 x 0.8	0.5 x 0.5	0.4 x 0.4	0.7 x 0.7	0.7 x 0.7	0.7 x 0.7	0.3 x 0.3	1.1 x 1.0	0.7 x 0.7	1 x 1	1 x 1
Matrix size	228 x 256	300 x 320	345 x 448	388 x 528	240 x 320	240 x 320	240 x 320	520 x 640	194 x 256	320 x 320	222 x 222	222 x 222
No. slices	160	192	23	34	23	34	72	96	160	144	23	34
Field of view, mm2	208 x 230	225 x 240	173 x 230	169 x 230	173 x 230	173 x 230	173 x 230	169 x 208	211 x 250	230 x 230	230 x 230	230 x 230
Slice thickness, mm	0.9	0.8	5	3	5	3	45108	44958	1	1	5	3
TE, ms	5	41365	111	69	127	123	20	15	298	467	90	56
TI, ms					2500	2600						
TR, ms	5000	5000	4560	7000	8500	9000	28	27	7000	9000	4200	4500
TA. min:s	0,334722	0,334722	0,15	0,152083	0,166667	0,163889	0,225	0,219444	0,301389	0,301389	0,086806	0,1
GRAPPA factor	2	3		2	2	3	2	3	3	3	3	4
RB/pixel. Hz/pixel	170	180	169	287	150	244	120	140	300	460	1186	1186
FA, degree	4	4	180	180	180	180	15	15	15	15	180	180
Fat saturation					Yes				Yes			

Figure 2. Sequences used on 3T and 7T and their parameters
Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5704893/table/T1/?report=objectonly

thus improve treatment outcomes. The first approved 7T device was from Siemens Medical Solutions Inc. called Magnetom Terra, and submitted data to the FDA from a study in which they recorded 3T and 7T MRI on 35 healthy subjects. The radiologists agreed that the 7T scans were of higher diagnostic quality. 7T MRI is allowed to be recorded on the head and extremities [9]. According to available information, 7T MRI has not yet been licensed for clinical use in Europe, but regardless, scientists in various research centers across Europe are using 7T MRI for research purposes, and it is only a matter of time before Europe gets the green light. Just some of the cities where 7T devices are installed are: Amsterdam, Frankfurt, Trondheim (Norway), Helsinki, London, Vienna [10-15]. In addition to ongoing research at 7T, the development of MRI does not stop there, and in institutions in Germany and the United States of America, MRI with a magnetic field strength of 9.4T is used for research purposes [16,17]. In South Korea, even an MRI of 11.7T strength is used for research purposes, which represents, according to available information, the strongest magnetic field [18].

Technological characteristics of 3T and 7T MRI

Since the very development and beginning of research on MRI whose magnetic field is as strong as 7T, efforts have been made to prove that there are many advantages over 3T. The biggest difference and advantage of 7T MRI is the doubled signal to noise ratio (SNR). The higher spatial resolution and contrast that 7T devices can provide means a better representation of lesions, microbleeds and small pathological changes that were not visible on MRI with weaker magnetic fields. Due to the reduced voxel size compared to 3T, increased spatial and contrast resolution, doctors were more confident in diagnosing images taken at 7T than at 3T. One of the problems that occurs with 7T MRI is the inhomogeneity of the B1 field, which can create artifacts in the images, but there are proposed solutions for it. One of the solutions is to adapt the design of radio frequency pulses and create a special sequence of these pulses. The newer design of the 7T MRI tries to solve all the observed problems, so it tries to reduce the weight of the device to make it easier to assemble. The acoustic volume produced by the 7T MRI device is also reduced to a minimum due to the strong gradient coils and the Lorentz force. Currently, the noise level permitted by the FDA is 99 dB with ear protection. 7T MRI is also faced with the problem of deposition of radiofrequency energy in the patient's body, so it is necessary to closely monitor these parameters and not allow them to exceed the permitted limits set by the FDA. In the United States, since the end of 2017, 7T has provided doctors with easier monitoring and treatment of patients with pathologies for which the best possible spatial resolution is important, such as: multiple sclerosis, drug-resistant epilepsy, Parkinson's and Alzheimer's disease, stroke and brain tumors [19-21].

Aim of the work

The aim of this paper is to compare magnetic resonance magnetic field strengths of 3T and 7T in brain imaging. By reviewing papers dealing with different brain pathologies, the similarities and differences between 3T and 7T are determined and the advantages and disadvantages of different field strengths are highlighted.

Discussion

Routine brain imaging on 3T and 7T MRI

The increasing number of 7T MRI machines in the world has raised the issue of imaging quality. A study by Springer E. et al. compared signal-to-noise ratio, contrast-to-noise ratio, and diagnostic accuracy in 10 sequences, 6 of which are shown in Figure 2. The results showed that 7T had higher SNR in all sequences except T1 MP2RAGE 3D, and the contrast was higher at 3T in the T1 MP2RAGE sequence. Diagnostic accuracy and reliability were significantly higher at 7T, with physicians giving the same opinion on 3T scans in 69.7% of scans and 93.3% on 7T. No significant difference in quality was found between 3T and 7T, and 7T scanning provides greater diagnostic accuracy in common neurological disorders [19].

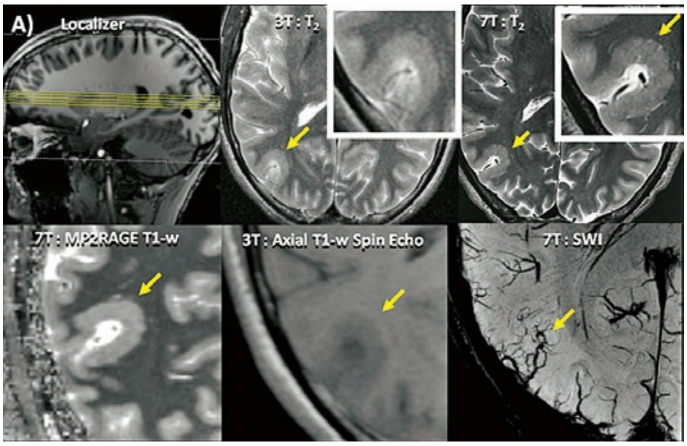

Figure 3. Presentation of images of patient seven at 3T and 7T
Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6424456/

Application of 3T and 7T MRI in epilepsy

Epilepsy is a serious brain disorder with different symptoms and causes, and genetics is the main cause. Currently, only 60-70% of patients respond to developed drugs, and refractory focal epilepsy can be treated surgically. In 20-30% of cases, MRI images are negative, which leads researchers to use a stronger magnetic field of 7T for better diagnosis and treatment [22]. Feldman RE. et al. conduct research on patients who have test results that do not show signs of lesions on 1.5T and 3T MRI and subject them to imaging on a 7T device. The results show that a change indicating an epileptogenic lesion was found in a total of 25 patients, which before the 7T MRI scan was not visible in other diagnostic procedures. Figure 3. shows cortical thickening caused by polymicrogyria that is less noticeable on a 3T T1 spin-echo sequence [22].

Wang I. et al investigated the value of 7T MRI in the clinical work-up of patients in order to demonstrate epileptogenic lesions caused by drug-resistant epilepsy that were not visible on previous 3T MRI. A standard protocol was used at 7T which was comparable to the performed 3T. The results showed the significance of 7T, which showed previously invisible changes in 50% of cases [23]. Studies conducted in 2021 reached the same results with the conclusion that 7T is of great importance compared to 3T because lesions in patients with drug-resistant epilepsy can be confirmed and better characterized [24, 25].

Veersema TJ et al. they dealt with focal cortical dysplasia. 7T MRI helped to detect the lesion in 23% of subjects and the patients were sent for further treatment. 7T also did not detect lesions in certain parts of the brain. It can be said that these lesions are visible, but due to the less experience of the doctor when reading the findings on 7T and the large number of images that need to be processed, it may happen that some lesions remain unnoticed [26]. This theory is also agreed by scientists who, in their recent research from 2022, said that the inexperience of doctors in reading findings on 7T can be a problem due to artifacts that do not appear at lower field strengths. These artifacts can lead doctors to think it is a lesion, leading to a false positive, so they suggest several pilot scans at 7T to allow experienced doctors to adjust to the changes that come with a higher magnetic field that were not present before [27]. Nevertheless, 7T MRI met expectations in this study and helped to detect focal cortical dysplasia [26].

Application of 3T and 7T MRI in multiple sclerosis

Multiple Sclerosis (MS) is an inflammatory and demyelinating disorder of the brain that has a direct impact on the white and gray matter of the brain and is characterized by specific lesions [28]. In their research, Maranzano J. and colleagues compared multi-contrast imaging at 3T and 7T, that is, the ability of the device to detect cortical lesions. Figure 4 shows some of the sequences performed on 3T and 7T. the upper row shows common subpial lesions detected at 3T and 7T, and the lower row shows negative findings of leukocortical lesions at 7T [29].

The conclusion is that the 3T protocol on MRI is appropriate. but that in clinical application 7T can be significant [29]. Numerous other studies that have dealt with the same or similar clinical issues [19, 30-33] come to the conclusion that the increase in spatial resolution and the increase in contrast provided by the 7T device is significant in the detection of cortical lesions.

Cocozza S. and colleagues arrive at the result that cortical lesions in the whole brain can be shown best on a 3D T1 WI sequence on a 7T MRI [34]. A research that dealt with a similar question singled out MP2RAGE in combination with T2* WI as the most adequate sequence, i.e. the

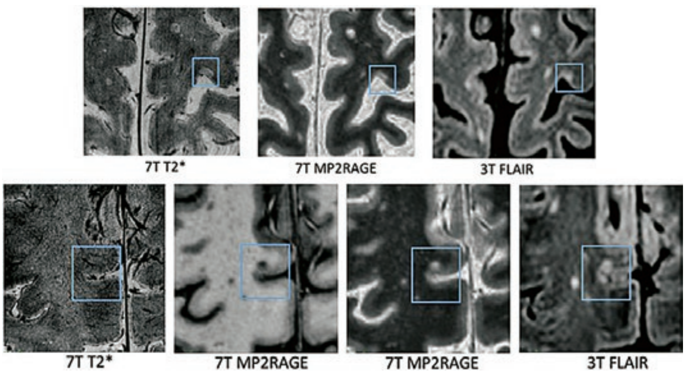

Figure 4. Presentation of cortical lesions detected by imaging on 3T and 7T MRI
Source: https://www.ajnr.org/content/40/7/1162.long

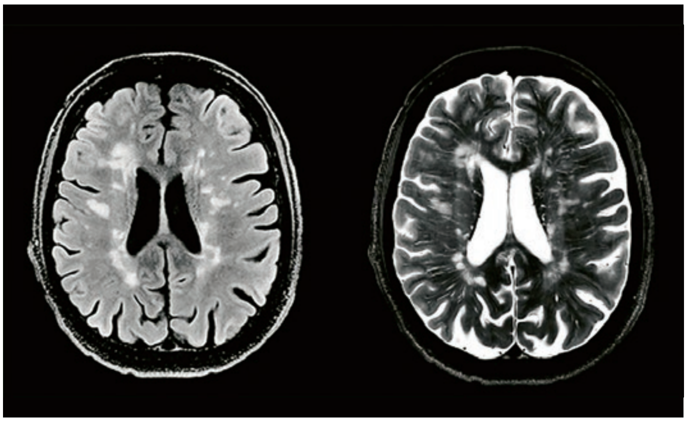

Figure 5. Display of a greater number of cortical lesions in the brain at 7T
Source: https://marketing.webassets.siemenshealthineers.com/527b4491ed39c3cc/f5cb6ea28399/2021_03_MAGNETOM_Terra_product_brochure.pdf

one that revealed the most lesions at 7T [35]. Figure 5 shows cortical lesions in different sequences at 7T [36].

Central venules in MS lesions are considered one of the hallmarks of the disease. In Figure 6, it is clearly marked with white arrows that the central venules are displayed in the Susceptibility-weighted imaging (SWI) sequence at both 3T (A) and 7T (B). The same pathology is difficult to notice on the corresponding T2-WI image at 3T (C) and 7T (D) [37].

Application of 3T and 7T MRI in brain tumors

Routine sequences on 3T are used daily in brain imaging and lead to the detection of tumors or are used to monitor tumors that have been previously detected. 7T MRI has proven to be useful in imaging tumors, especially gliomas, and showing their internal structure, i.e. microvasculature [19].

In a recently published study, February 2023, scientists investigated the diagnostic value of 7T MRI and the importance of this device in brain imaging compared to standard 3T. The goal of their research was to come to the conclusion whether there are enough advantages of the 7T device compared to the 3T for clinical use. The results showed that, on the same CE-MP2RAGE sequence, the quality of the image, the representation of the internal structure of the tumor and the arteries feeding it were significantly higher on 7T MRI. Visualization of internal structures is important in clinical practice, and for the same reason doctors had higher diagnostic accuracy on 7T. Their confidence in diagnosing tumors at 7T was greater the more experienced they were. The 3T MRI scans in the CE-MP2RAGE sequence were of good quality and suitable for use in clinical practice, but the advantages at 7T may be of great benefit in the future [38]. Figure 7 shows an extremely high-quality 7T image, which is proof of how much the increased signal-to-noise ratio means when showing vascularization, namely glioblastoma, from which the patient on the image suffers [36].

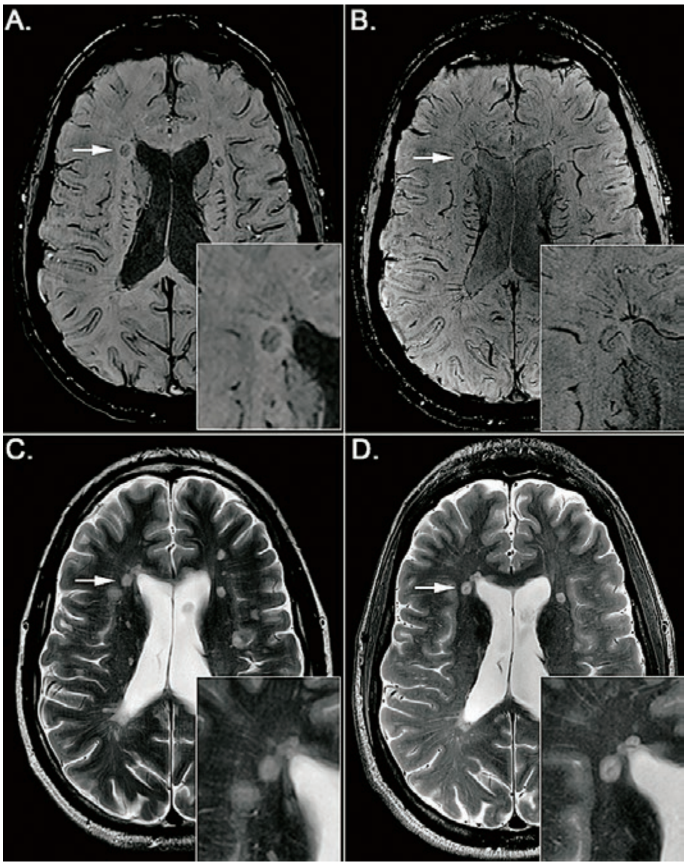

Figure 6. 3T (A and C) and 7T (B and D) MRI of a patient suffering from MS
Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5832016/

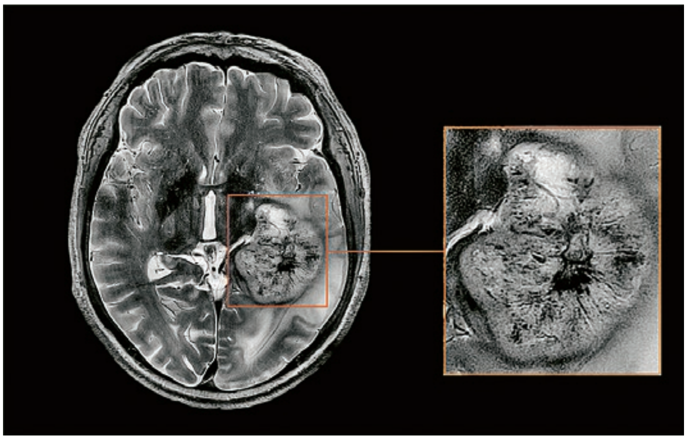

Figure 7. Display of glioblastoma vascularization on 7T MRI
Source: https://marketing.webassets.siemens-healthineers.com/527b4491ed39c3cc/f5cb6ea28399/2021_03_MAGNETOM_Terra_product_brochure.pdf

One of the most recent studies was published in April 2023, and scientists investigated the advantages of 7T in delineating gliomas of different grades compared to 3T MRI. The delineation of tumor boundaries is extremely important in the surgical procedures to which patients are usually exposed, and they investigated whether MRI could be of greater benefit in this area. After 3T and 7T imaging were performed on the patients, the results were that, although 7T showed a smaller tumor area than 3T on some sequences, the overall delineation ability of 3T and 7T MRI was similar and the overall conclusion is that both

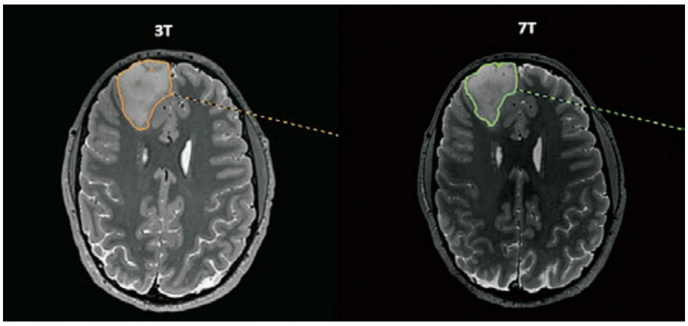

Figure 8. Presentation of glioma delineation in the frontal lobe on 3T and 7T MRI
Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10137409/

devices can use. Figure 8 shows 3D T2 sequences on 3T and 7T MRI [39].

Application of 3T and 7T MRI in stroke

Stroke is one of the most common causes of death and disability in the world. MRI is considered the best modality for monitoring and detecting strokes. Currently, clinical practice is to use 1.5 T and 3 T MRI in stroke protocols, but ultra-high-field MRI such as 7 T can be of great value because of the increased spatial resolution and contrast that play a major role in the detection of millimetric changes. There are several types of strokes, and the most common are ischemic strokes, which account for about 80% of all strokes, and hemorrhagic strokes, which account for about 20% [40]. Figure 9 shows an axial contrast-enhanced 3D-FLAIR sequence, and on the image marked with arrows, due to the high resolution, it is clearly seen that the hyperintense border surrounds the putamen and the globus pallidus (arrowheads), which appears hypointense due to blood components. A smaller infarct is also seen in the insular region (black arrow), and multiple hyperintense dots are also seen along the ventricular border (white arrow) [40].

7T MRI showed superiority in the depiction of cerebral aneurysms, microbleeds and vascular malformations. A

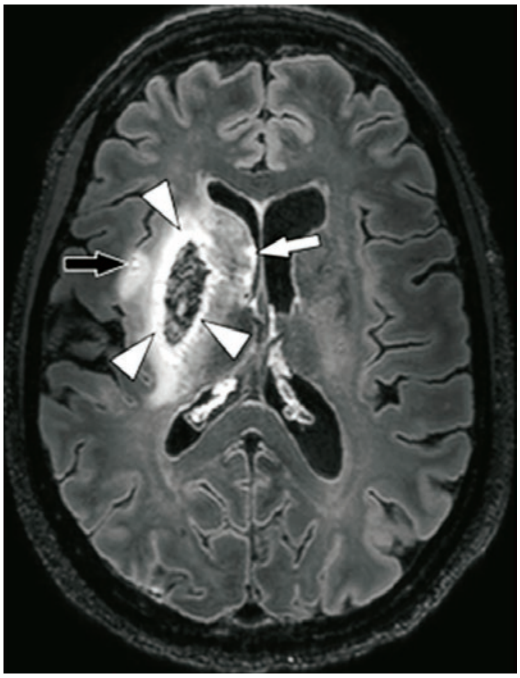

Figure 9. Presentation of ischemic stroke at 7T
Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5862656/

better representation of these pathologies and a higher-quality recording is made possible by a higher spatial resolution due to the higher strength of the magnetic field [19, 41].

The use of 7T MRI-angiography in the diagnosis of stroke

It is already known that increasing the strength of the magnetic field increases the value of T1 in tissues. This increased value, together with a high signal-to-noise ratio, enables increased tissue suppression of the static background signal in Time of flight (TOF) angiography, which increases the overall contrast and improves the visualiza-

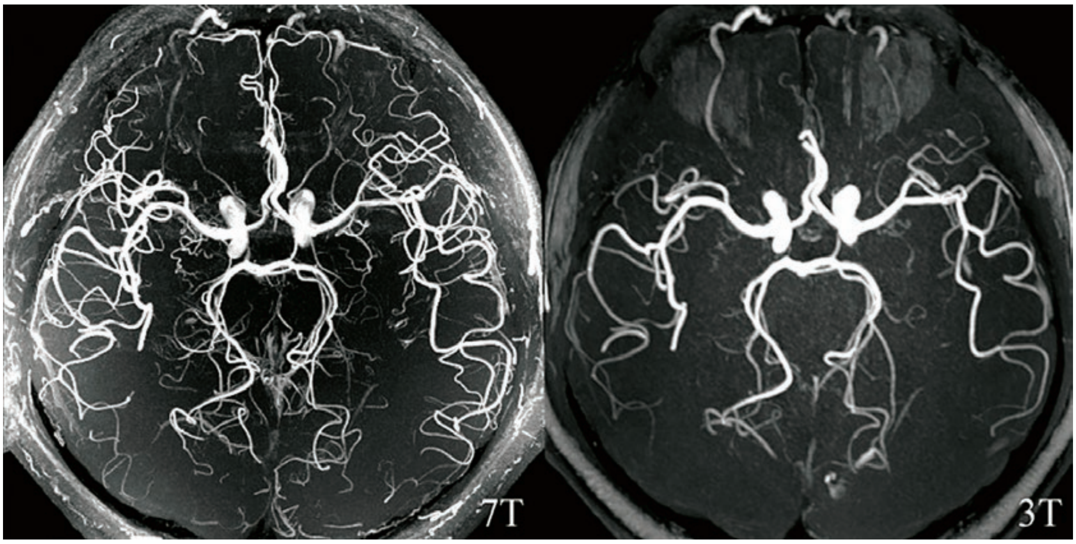

Figure 10. MRI angiography on 3T and 7T MRI
Source: https://svn.bmj.com/content/7/6/550

Figure 11. TOF MRI angiography on 7T MRI
Source: https://marketing.webassets.siemens-healthineers.com/527b4491ed39c3cc/f5cb6ea28399/2021_03_MAGNETOM_Terra_product_brochure.pdf

tion of small arteries on the images [21]. It is noticeable that 7T MRI provides better image quality and details of the pathological change compared to the 3T device (Figure 10) [42].

Figure 11 shows a TOF MRI angiography at 7T, which shows how good and detailed a view of the smallest intracerebral blood vessels is provided by this modality [36].

Neurodegenerate diseases on 3T and 7T MRI

Alzheimer's disease

Alzheimer's disease, dementia that affects both the elderly and the younger population, is characterized by cognitive impairment (Figure 12). MRI, especially 7T MRI, can detect changes in the cerebral cortex, especially cortical changes caused by iron deposits. The high spatial resolution of the device enables a detailed examination of the hippocampus, a key early sign of Alzheimer's disease. This makes 7T an effective diagnostic tool for detecting brain changes caused by Alzheimer's disease, demonstrating its sensitivity and efficiency [21, 43-45].

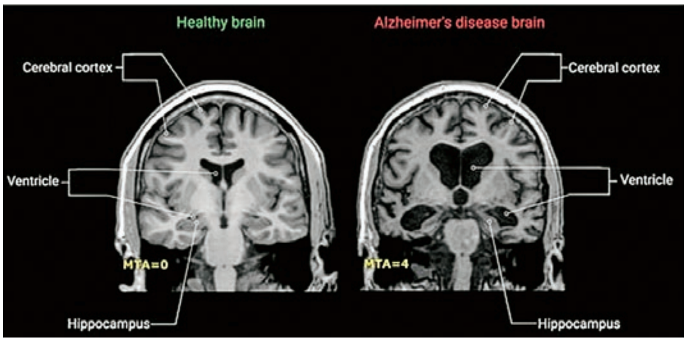

Figure 12. MRI of a healthy brain and a brain affected by Alzheimer's disease
Source: https://www.mdpi.com/1422-0067/22/4/2110

Parkinson's disease

Parkinson's disease is a neurodegenerative disease characterized by motor and non-motor symptoms, Lewy bodies and loss of dopaminergic neurons. Current diagnostic modalities often lack anatomical views of the substantia nigra (SN), making them limited in diagnosis. SN can be visualized on 7T MRI due to the increased spatial resolution and contrast, which allows the visualization of nigrosomal formations in the affected area (Figure 13) [46, 47].

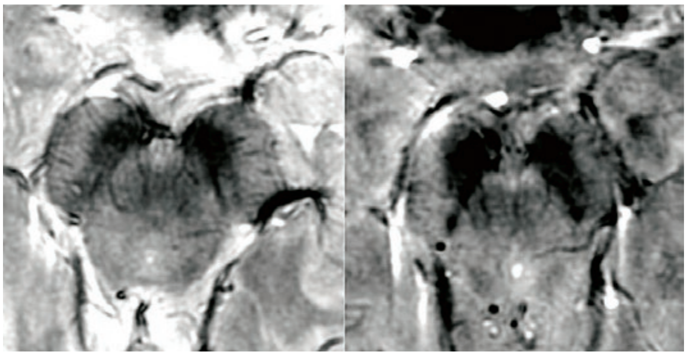

Figure 13. 3T (right) and 7T (left) MRI of the midbrain in a healthy volunteer
Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8013050/

Disadvantages and safety assessment of 7T MRI

The scientists discovered technical problems with the 7T MRI imaging device, including inhomogeneity of the main magnetic field (B0), inhomogeneity of the applied radiofrequency (RF) field (B1), increased specific absorption rate (SAR) and increased susceptibility to artifacts during patient movement (Figure 14). These questions are related to the different magnetic susceptibility between the air cavities in the skull and those in the brain tissue. To solve these problems, researchers develop sequences and adjust imaging parameters. B1 field inhomogeneity is a major problem, and solutions include the use of di-

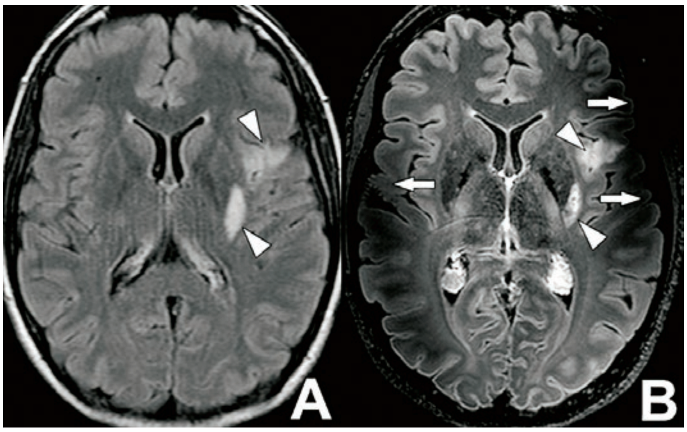

Figure 14. Brain MRI view at 3T (A) and 7T (B) showing artifacts at 7T
Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5862656/

electric pads, changes in RF pulse application and parallel imaging techniques. The most noticeable changes are in the temporal lobes [40, 48].

The undeniable increase in image quality, increase in spatial resolution and contrast on the 7T comes with a concern for safety when applying such high magnetic field strengths. In order to review studies on safety aspects and investigate where there is a lack of knowledge and information for the development of further research, the International Society for Magnetic Resonance in Medicine (ISMRM) is being developed. The main goal of the foundation was to provide enough information to radiologic technologists, physicists and radiologists to be able to make the right decisions primarily related to 7T MRI safety in their institution. Radiologic technologists, physicists and radiologists should be thoroughly familiar with how the applied RF pulse can affect the implants a patient may have and how changes in imaging parameters and different techniques can affect image quality [49]. The scientists gave their opinion on the use of 7T MRI with implants that are not allowed at 7T, but which are safe and approved for use at 3T. They consider that the main factor for the imaging decision is the distance from the RF coil, stating that this is due to the absence of a whole-body RF coil on 7T MRI [50]. It can be said that 7T MRI is safe for human use, but professional personnel working with 7T magnetic field strength devices must consider the more complicated interaction of RF pulses with tissues and implants and be aware that there are certain limitations of the device that need special attention. Radiologic technologists must be careful when imaging patients who have implants or jewelry that cannot be removed, also tattoos or permanent makeup that cannot be removed can pose a safety risk because more heating is present [49, 50].

Conclusion

7T MRI provides images with higher spatial resolution and better contrast, which proves to be significant in the display of epileptogenic lesions, lesions specific to multiple sclerosis, detailed display of the internal structure of brain tumors, small hemorrhages and aneurysms significant for stroke, and changes in the brain that occur in neurodegenerative diseases such as Alzheimer's and Parkinson's disease. 7T MRI still needs to be investigated, especially in areas described by different studies such as inhomogeneities of the main magnetic field and applied RF field or increased specific absorption dose. A major role is played by the radiological technologist who, when processing patients at 7T, must take into account various parameters of this device and be aware of the potential danger of greater heating of objects that the patient may own. Scientists agree that 7T MRI is safe for use on patients and will be used in clinical use in other parts of the world in the future. In the meantime, research continues on the 7T MRI, but also on other high-field MRI devices that have the potential to provide high-quality healthcare in the future and thus contribute to the development of medicine as it is known today.

All data in this paper are part of the results of the undergraduate thesis "Technological comparison of magnetic resonance 3T and 7T in brain imaging" written at the University Department of Health Studies, University of Split [51].

Usporedba 7T MR i 3T MR u dijagnostici bolesti mozga

Sažetak

MR je uvelike unaprijedila dijagnostičku medicinu u posljednjim desetljećima. Stalnim mijenjanjem i unaprjeđivanjem tehnoloških aspekata, MR postaje sve sofisticiranija i finija metoda. Stalnom težnjom da se povećava korišteno magnetno polje, zbog povećanja SNR-a povećava se prostorna rezolucija i kontrastnost. Ti faktori omogućuju detaljan i jasan prikaz ranije nevidljivih patologija, naročito patologija u mozgu. Cilj ovog rada je usporediti važnost tehnoloških značajki 3T i 7T MR-a u oslikavanju mozga te izdvojiti njihove prednosti i nedostatke. 3T MRI se koristi u svakodnevnoj kliničkoj primjeni diljem svijeta. Jedno od osnovnih pitanja kojim se znanstvenici bave u većini istraživanja je značajnost 7T u odnosu na 3T pri prikazu različitih patologija mozga. Utvrđeno je da poboljšane tehnološke karakteristike uređaja većeg magnetnog polja utječu na bolji prikaz epileptogenih lezija i lezija koje su specifične za multiplu sklerozu. Osim toga dobiva se i bolji prikaz unutarnje strukture tumora, bolji prikaz aneurizmi i mikrokrvarenja te promjena koje su karakteristične za neurodegenerativne bolesti kao što su Alzheimerova bolest i Parkinsonova bolest. Bilo je od velike važnosti utvrditi postoji li superiornost 7T kod ovih patologija da bi se utvrdile sve dostupne mogućnosti, prednosti i nedostaci jer su to bolesti koje imaju sve veću prevalenciju u populaciji. Na 7T MR-u susreću se i tehnološki problemi koji mogu dovesti do loše kvalitete snimke, za njih se predlažu i istražuju različita rješenja. Pregledom brojnih istraživanja, utvrđeno je da je 3T MR kvalitetan uređaj za trenutnu primjenu, ali 7T ima mogućnost prikaza detalja i može pružiti kvalitetniju snimku i veću dijagnostičku preciznost te može biti od velikog značaja, posebice kod određenih pacijenata gdje 3T nije dovoljno detaljan. Treba uzeti u obzir da se 7T MR još uvijek treba istraživati, ali sigurna je za upotrebu na čovjeku i predstavlja budućnost dijagnostičke medicine.

Ključne riječi: magnetno polje, mozak, 3T MR, 7T MR

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