Decoding Epilepsy: The Added Value of Magnetic Resonance Diffusion Tensor Imaging and Fiber Tractography in Conventional MRI-Negative and Positive Patients

Ashraf Mohammed Elaggan[a*],Mohamed Fouad Sherif[a], Ashraf Ali Abo-el-Safa[b], Alshaimaa Zakaria Elshahawy[a]

[a]Radiodiagnosis Department, Faculty of Medicine, Tanta University, Tanta, Egypt.
[b]Neuropsychiatry Department, Faculty of Medicine, Tanta University, Tanta, Egypt.

Abstract

Background: Temporal lobe epilepsy (TLE) is the most prevalent localized condition associated with epilepsy syndrome and is often unresponsive to any medical treatment.

Objectives: This study aimed to assess the role of diffusion tensor imaging (DTI) and diffusion tensor tractography in the evaluation of TLE patients.

Patients and methods: This study was included 40 TLE patients were clinically diagnosed by a neurologist as TLE, either due to hippocampal sclerosis or other organic cause and were included if they had a seizure-free-period for one week before the radiological assessment. Twenty healthy volunteers as a control.

Results: The mean fractional anisotropy (FA) of the studied white matter tracts was significantly lower in the patient than in the control group (P<0.001). The DTI parameters showed agreement with the conventional MRI findings in 26 patients (65.0%). However, the present study revealed that DTI parameters were affected among the 14 patients (35%) with normal conventional MRI. Studying the association between the degree of FA reduction and some clinical factors (age at onset of the seizure, disease duration, and seizure frequency) was carried out. The degree of FA reduction was positively correlated with the duration of the disease and seizure frequency and negatively correlated with age at the onset of epilepsy. There was a significant correlation between FA reduction and the disease duration (r=0.333, P=0.036).

Conclusion: DTI parameters and MRI tractography are new structural imaging methods that provide sensitive markers to early identify and lateralize hippocampal abnormalities in TLE patients, particularly in patients with negative conventional MRI.

Keywords: Temporal Lobe Epilepsy; Magnetic Resonance Imaging; Diffusion Tensor Imaging.

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***Correspondence:** ashrafelagan@yahoo.com

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Introduction

Mesial temporal sclerosis (MTS) is the most frequently observed pathology in temporal lobe epilepsy (TLE). Other pathologies include focal abnormalities of gyration, and cortical dysgenesis, such as focal cortical dysplasia or tumor **(Villamizar-Torres et al., 2024)**.

The main purpose of using magnetic resonance imaging (MRI) for epilepsy is to determine the cause of the seizures and also to prepare for possible surgical procedures. MRI has a great deal of information about brain anatomy and possible tiny lesions, and it can accurately define the area where seizures are most likely to occur after surgery **(Rondinoni et al., 2021)**. However, standard MRI has been found to be negative in as many as 30–40% of focal epilepsy patients in prior research. Additionally, existing 3T MRI machines are unable to detect as many as 40% of focal cortical dysplasias, according to a prior study **(van Lanen et al., 2021)**. Diffusion tensor imaging (DTI) and other innovative structural MRI neuroimaging techniques have been developed to accomplish the aforementioned goals and reduce the number of patients who test negative for MRI **(Uher et al., 2023)**.

DTI is a cutting-edge imaging technique that reveals information about the brain's white matter structure via the diffusion of water. In addition, it can help with the extraction of the three-dimensional (3D) location of white matter tracts that are hard to detect and study using traditional imaging techniques **(Martinez-Heras et al., 2021)**. DTI and MRI tractography can also guide optimal neurological resections in individual patients with a reduced risk of causing deficits **(Ghonim et al., 2025)**.

The fact that some individuals can have perfectly normal MRI scans is the main drawback of traditional MRI in patients with TLE. By contrast, DTI is sensitive to intra- and inter-ictal physiological changes in the brain tissues **(Mohsen et al., 2020)**.

Previously published research examined the diagnostic usefulness of DTI in identifying hippocampal anomalies and lateralizing the temporal-lobe seizure center in a sequential cohort of patients with TLE undergoing epilepsy surgery **(Amr O.M.A. Azab and Asmaa M. Ebraheim, 2018)**. Mean diffusivity (MD) and fractional anisotropy (FA) measurements in the epileptogenic hippocampal formation (HF) were significantly different from contralateral values **(Winston et al., 2020)**. Moreover, DTI may also be affected by the pattern of seizure propagation. A previous study reported that seizure spread was associated with increased FA in relevant tracts, which may suggest the augmentation of structural connectivity **(Gleichgerrcht et al., 2021)**.

Subcortical areas such as the thalamus, amygdala, and hippocampus ipsilateral to the seizure focal have also shown diffusion alterations in white and grey matter tissues, according to both DTI and tractography **(Reda et al., 2023)**.

Although earlier DTI research has shed light on the degree of white matter abnormalities in TLE, the use of DTI in routine clinical practice remains restricted. Additional research, particularly longitudinal studies in patients with newly diagnosed or recent-onset epilepsy, is required **(Alizadeh et al., 2019)**.

The study aimed to determine how useful DTI and other similar techniques are for evaluating patients with TLE.

Patients and methods

We performed a retrospective analysis using data prospectively collected from June 2024 to the end of December 2024. This study was carried out on 40 TLE patients in their interictal period. The patients were clinically diagnosed by a neurologist as TLE, either due to hippocampal sclerosis or other organic cause and were included if they had a seizure-free-period for one week before the radiological assessment. The exclusion criteria included hypertension, diabetes mellitus, cardiac diseases, renal failure, or

any of the following medical conditions that would prevent them from receiving an MRI: cardiac pacemakers, intracranial clips from arterial brain aneurysms that are not compatible with MRI, a metallic cochlear implant, an insulin pump, a metallic ocular foreign body, a Swan-Ganz catheter, or any other similar device. Twenty healthy individuals were enlisted as the control group. The research study was conducted from January to June of 2023. The study was approved by the ethics committee with approval code (36264PR1039/1/25). All participants were provided informed consent after a thorough discussion about the advantages and risks. The confidentiality of data is guaranteed and used only for scientific research purposes.

Data collection

A thorough medical history, clinical examination, and electroencephalography (EEG) were all conducted to validate the clinical diagnosis of TLE and to enable the lateralization of the seizure center for comparison with the DTI results. All patients received interictal daytime EEG using the 10-20 international method. Recordings were performed using Schwarzer GmbH (version: 4.00-0.00) patch pack: 5 equipment.

MR examination

All enrolled patients performed MRI examination using a 1.5 Tesla machine (GE SIGNA explorer). MRI was done according to the epilepsy imaging protocol in our institution without preparation or anesthesia. A Head coil was used (16 channel).The sequences obtained were axial T1WI (TR = 450 ms, TE = 15 ms, Flip angle = 69˚, Matrix = 180 x169, field of view (FOV) = 210 x 236 mm^2 , number of excitations = 2, slice thickness = 6.0/1.5), coronal T2WI (TR = 2.2 s, TE = 100 ms,Flip angle = 90˚, FOV = 200 mm, slice thickness = 4.0/-0.01) and coronal FLAIR (TR = 8.0 s, TE = 125 ms, Flip angle 90˚, FOV = 200 mm, slice thickness = 4.0/-0.01) on temporal lobe as well as DTI (A single shot, spin-echo echo planar sequence in 40 encoding directions with a weighting factor of diffusion = 800 s/mm2, TR = 8000 ms, TE = 67 ms, Flip angle = 90˚, matrix = 112 x 110, FOV = 210 x 236 mm, number of excitations = 2, slice thickness = 2.0/00) **(Shawky et al., 2019)**.

MRI analysis

On the manufacturer-supplied workstation (GE extended MR workspace), all images were transmitted. Post-processing was done using GE tractography software. FA maps, colored FA maps with directional coding and 2-dimensional (2D) fiber tractography maps were acquired in all patients. The neurogenic tracts' structure and their direction were shown on the directionally encoded FA maps, which used color mapping to depict the tracts in three orthogonal directions: green for anteroposterior tracts, craniocaudal tracts, and right-to-left tracts. Based on known anatomy, MRI tractography of the white matter tracts (Arcuate fasciculus, uncinate fasciculus, inferior fronto-occipital fasciculus (IFOF), and inferior longitudinal fasciculus (ILF)) was done. By employing the multiple-ROI method, the computer was able to track the white matter tracts as they passed through pre-established ROIs that had been planted along the tracts' anatomical journey **(Chianca et al., 2023)**.

In patient group, the conventional MRI images were carefully interpreted with special interest at the hippocampal regions searching for signs of hippocampal sclerosis (HS) or other causes of TLE such as tumors or congenital malformations. In patient and control groups, FA maps were analyzed with measuring FA values at hippocampal regions as well as white matter tracts and compared with the contralateral side. After that, the aforementioned white matter tracts were mapped using color-coded DTI images. MRI data were interpreted by three neuro-radiologists blinded to clinical data with inter-observer agreement.

Statistical analysis

The SPSS software (Statistical Package for the Social Sciences) version 22 computer program was employed to conduct data presentation and statistical analysis. Shapiro-Wilk tests were implemented to ascertain the normality of each numerical variable. The mean ± SD was employed to represent numerical variables that were normally distributed. An independent T-test was implemented to ascertain disparities between the two groups. Frequencies and percentages of categorical variables were computed, and the relationship between variables was ascertained through X2 tests (Pearson's Chi-square for independence or Fisher Exact tests whenever applicable). A p value of less than 0.05 was regarded statistically significant, while a p value of less than 0.001 was considered extremely significant.

Results

Patients Characteristics

There were 40 TLE patients in the study; 25 were males (62.5%) and 15 were females (37.5%). The age of enrolled patients ranged between 13 and 38 years, with an average of 25.5 ± 9.9 years. Twenty healthy individuals were recruited as a control group, about (60.0%) of the group were males, while females constituted (40.0%). The age of the control group ranged from 23 to 36 years with a mean of 29.1 ± 5.4 years.

EEG and conventional MRI findings

The most common EEG findings among enrolled patients were left (Lt) temporal epileptogenic dysfunction in 17 patients (42.5%), bitemporal activity with Lt side predominance in 8 patients (20.0%), followed by right (Rt) temporal epileptogenic dysfunction in 7 patients (17.5%), and centrotemporal epileptogenic dysfunction in 4 patients (10.0%). Concerning conventional MRI findings, 14 patients (35.0%) showed no evidence of temporal lobe lesions, while Lt hippocampal sclerosis was detected in 8 patients (20.0%), and Rt hippocampal sclerosis in 7 patients (17.5%). Lt temporal pole gliosis as well as Lt temporal mixed cystic and solid mass each was found in 4 patients (10%). Additionally, 3 patients (7.5%) showed Lt temporal lobe oligodendroglioma. (**Table.1)**

Table 1. Electroencephalographic and conventional MRI findings of the studied patients

Variables		N = 40	P
EEG	Lt temporal epileptogenic dysfunction	17(42.5%)	0.007*
	Bilateral temporal shifting lateralization with Lt side predominance	8(20.0%)	
	Rt temporal epileptogenic dysfunction	7(17.5%)	
	Centrotemporal epileptogenic dysfunction	4(10.0%)	
	No abnormality	4(10.0%)	
MRI	No evidence of temporal lobe lesions	14(35.0%)	0.029*
	Lt hippocampal sclerosis	8(20.0%)	
	Rt hippocampal sclerosis	7(17.5%)	
	Lt temporal pole gliosis	4(10.0%)	
	Lt temporal mixed cystic and solid mass	4(10.0%)	
	Lt temporal lobe oligodendroglioma	3(7.5%)	

Data are presented as frequency (%). *Significant value $p < 0.05$. EEG: Electroencephalography, MRI: magnetic resonance imaging.

Diffusion-based MRI tractography

Patients with HS had reduced color hue of the tracts, whereas those with temporal lobe tumors exhibited patterns of affection such as edema, displacement, infiltration, or destruction of the tracts.

Significant variations were found between the patient and control groups when comparing the Lt and Rt diffusion-based MRI tractography ($p<0.001$). Patient group mean FA of the white matter tracts examined (arcuate fasciculus, uncinate

fasciculus, IFOF, and ILF) was significantly lower than control group for all patients included in the study. In contrast, the control group's mean apparent diffusion coefficient (ADC) was significantly lower than that of the patient group. (**Table.2).**

Table 2. Comparison of left and right diffusion-based magnetic resonance tractography parameters between the studied groups

Bilateral temporal lesion		Groups		P value
		Study N=40	Control N=20	
Arcuate fasciculus	RT FA	0.28±0.07	0.65±0.01	<0.001*
	RT ADC	1.86±0.27	1.02±0.04	<0.001*
	LT FA	0.25±0.04	0.65±0.01	<0.001*
	LT ADC	2.24±.30	1.02±0.04	<0.001*
Inferior fronto-occipital fasciculus	RT FA	0.32±0.01	0.65±0.01	<0.001*
	RT ADC	1.92±0.06	1.02±0.04	<0.001*
	LT FA	0.30±0.09	0.65±0.01	<0.001*
	LT ADC	2.09±0.09	1.02±0.04	<0.001*
Inferior longitudinal fasciculus	RT FA	0.27±0.05	0.65±0.01	<0.001*
	RT ADC	1.52±0.10	1.02±0.04	<0.001*
	LT FA	0.35±0.04	0.65±0.01	<0.001*
	LT ADC	2.05±0.06	1.02±0.04	<0.001*
Uncinate fasciculus	RT FA	0.33±0.02	0.65±0.01	<0.001*
	RT ADC	1.82±0.06	1.02±0.04	<0.001*
	LT FA	0.36±0.04	0.65±0.01	<0.001*
	LT ADC	2.21±0.24	1.02±0.04	<0.001*

Data are presented as mean± SD. * Significant P value <0.05. ADC: apparent diffusion coefficient, FA: fractional anisotropy, RT: right, Lt: left.

The DTI parameters showed agreement with the conventional MRI findings both in the Lt temporal and the Rt temporal lobes affection of all white matter tracts (25% and 30%, respectively). Four patients (10%) showed only affection of the Rt temporal lobe ILF and uncinate fasciculus that was also in agreement with the conventional MRI data. However, the present study revealed that DTI parameters of all white matter tracts were affected among the 14 patients (35%) with normal conventional MRI. Eight patients (20%) of them showed affection of both temporal lobes, whereas the remaining 6 patients (15%) showed affection of the Lt temporal lobe tracts. (**Table.3).**

Table 3. Frequencies of affection at the studied white matter tracts in comparison with MRI findings

Variables	N=40
Affected all tracts of both temporal lobes but normal MRI (+VE DTI and -VE MRI)	8(20.0%)
Affected all tracts of LT temporal lobe confirm MRI data (+Ve DTI and +Ve MRI)	10(25.0%)
Affected all tracts of LT temporal lobe but normal MRI (+VE DTI and -VE MRI)	6(15.0%)
Affected all tracts of RT temporal lobe confirm MRI data (+Ve DTI and +Ve MRI)	12(30.0%)
Affected Rt temporal lobe Inferior longitudinal fasciculus and uncinate fasciculus that confirm MRI data (+Ve DTI and +Ve MRI)	4(10.0%)

Data are presented as frequency (%). MRI: magnetic resonance imaging, DTI: Diffusion tensor imaging.

In this study the relation between the disease characteristics (disease duration, seizure frequency, and age at onset of epilepsy) and DTI findings was assessed **(Table.4)** and revealed:

- A negative correlation between the age at onset of epilepsy and the FA differences between both temporal lobes, but it did not show statistical significance.
- A positive correlation between the duration of illness and the FA difference between both temporal lobes.
- A positive correlation between the seizure frequency and the FA difference between both temporal lobes, yet without statistical significance.

Table 4. Correlation between FA difference between tracts of both temporal lobes and age of onset, duration of illness and seizure frequency in patient group

Variables	FA difference between tracts of both temporal lobes	
	Spearman rho correlation Coefficient	p value
Age of onset, years	-0.007	0.967
Duration, years	0.333	**0.036***
Seizure frequency/day	0.239	0.138

*Significant value p<0.05. FA: fractional anisotropy.

Case 1: A 28-year-old male patient, presented with seizure. He was clinically diagnosed as having TLE 6 months ago. EEG revealed Rt temporal epileptogenic dysfunction. Conventional MRI Revealed signs of Rt temporal lobe low grade glioma. Post-processing DTI revealed decreased FA and increased ADC of Rt temporal lobe tracts with severely increased FA difference between both sides. This denotes positive affection of Rt side matched with conventional MR findings. **(Fig.1)**

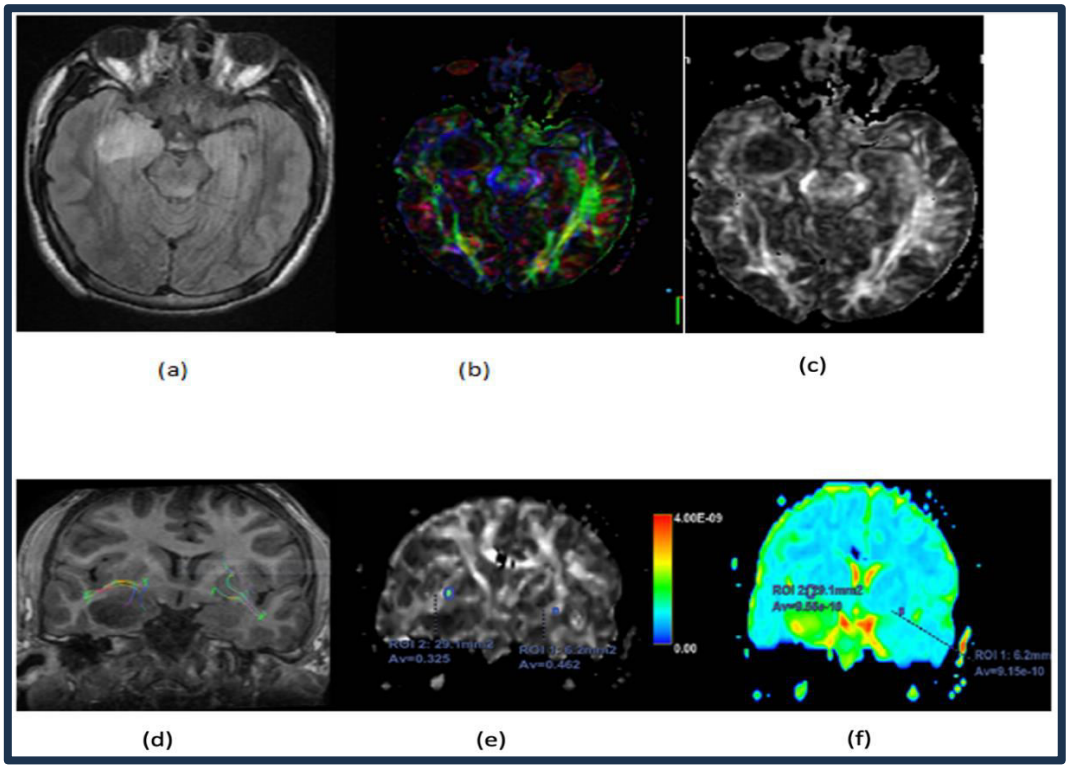

Fig.1. (a) Axial T2 FLAIR MRI image shows Rt temporal heterogeneous mass with mainly high signal intensity (SI) and eccentric area of low SI most probably low-grade

glioma (ganglioma). (b) Axial color FA map shows altered color on Rt temporal lobe and affection of the tracts by the Rt temporal lobe mass, the color code reveals the fiber direction; red = left to right, blue = cranio-caudal, and green = anterior-posterior (c) Axial FA map reveals decreased intensity of the Rt temporal lobe tracts. (d) Coronal 2D tractography image shows the Rt uncinate fasciculus deviated by the tumor (e) Coronal FA map reveals measurement of FA at temporal lobes on both sides = 0.325 on Rt side while 0.462 on Lt side with a FA difference = 0.025 (f) Coronal color ADC map shows measurement of ADC at temporal lobes on both sides = 9.56e.10 on Rt side while 9.15e.10 on Lt side

Case 2: A 32-year-old female patient, presented with seizure 8 months ago. She was clinically diagnosed as having TLE. EEG revealed Lt temporal epileptogenic dysfunction. Conventional MRI showed Lt temporal lobe partially solid partially cystic intra-axial mass for differential diagnosis (ganglioglioma, DNET, pleomorphic xanthoastrocytoma). Post-processing DTI revealed decreased FA and increased ADC of Lt temporal lobe tracts with severely increased FA difference between both sides. This denotes positive affection of Lt side matched with conventional MR findings. (**Fig.2).**

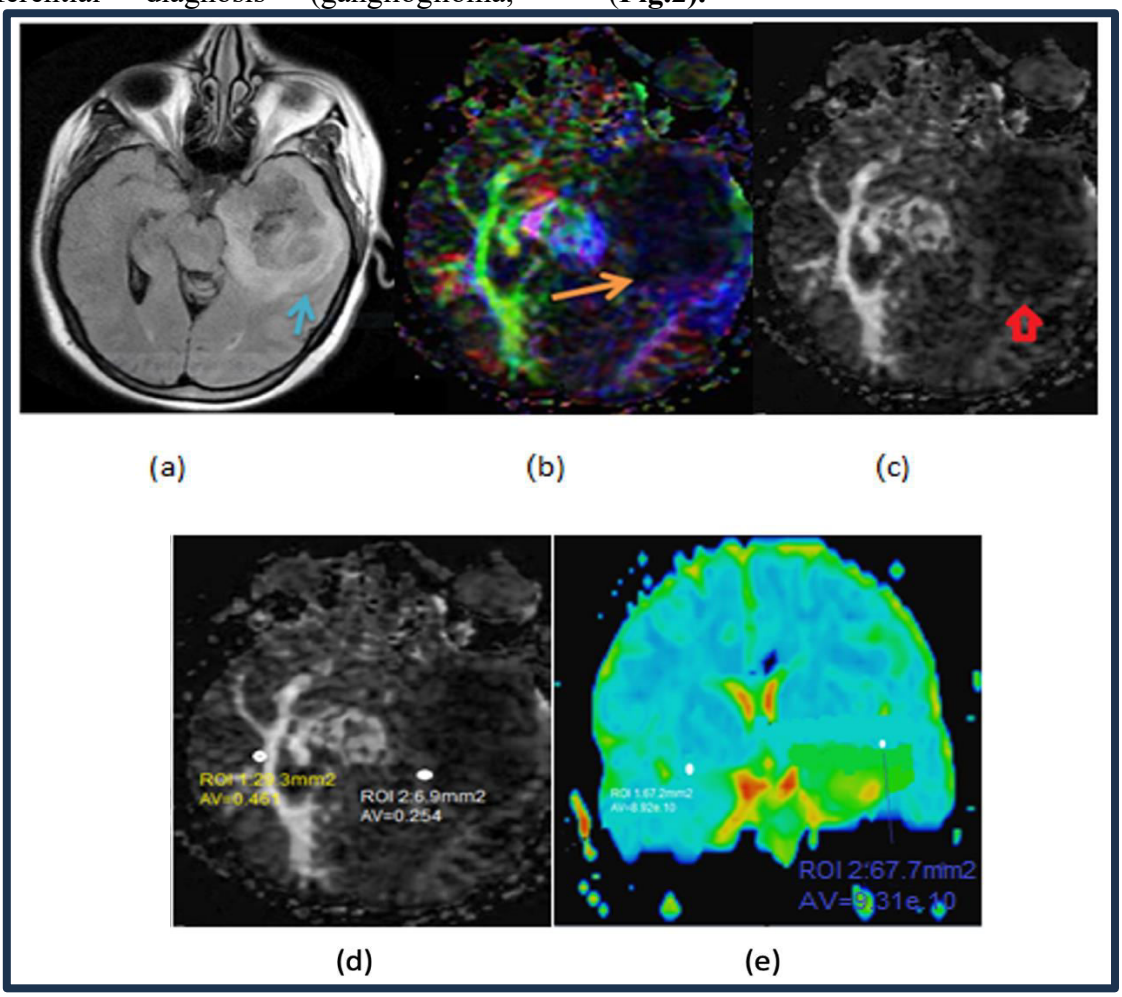

Fig.2. (a) Axial FLAIR MRI image shows Lt temporal lobe partially solid partially cystic intra-axial mass (arrow). (b) Axial color FA map shows loss of integrity and color hue of Lt temporal lobe (arrow), the color code reveals the fiber direction; red = left to

right, blue = cranio-caudal, and green = anterior-posterior. (c) Axial FA map reveals destruction and displacement of white matter tracts of Lt temporal lobe. (d) Axial FA map reveals measurement of FA at temporal lobes on both sides = 0.254 on Lt side while 0.461 on Rt side, FA difference = 0.207. (e) Coronal color ADC map shows measurement of ADC at temporal lobes on both sides = 9.31e.10 on Lt side while 8.92e.10 on Rt side

Case 3: A 31-year-old male patient, presented with seizure started when he was one year old. He was clinically diagnosed as having TLE. EEG revealed Rt temporal epileptogenic dysfunction. Conventional MR showed no signs of hippocampal sclerosis with no evidence of temporal lobes lesions (-ve MRI). Post-processing DTI revealed decreased FA and increased ADC of all tracts of Rt temporal lobe. This denotes positive affection of Rt side mismatched with conventional MRI findings. (**Fig. 3)**

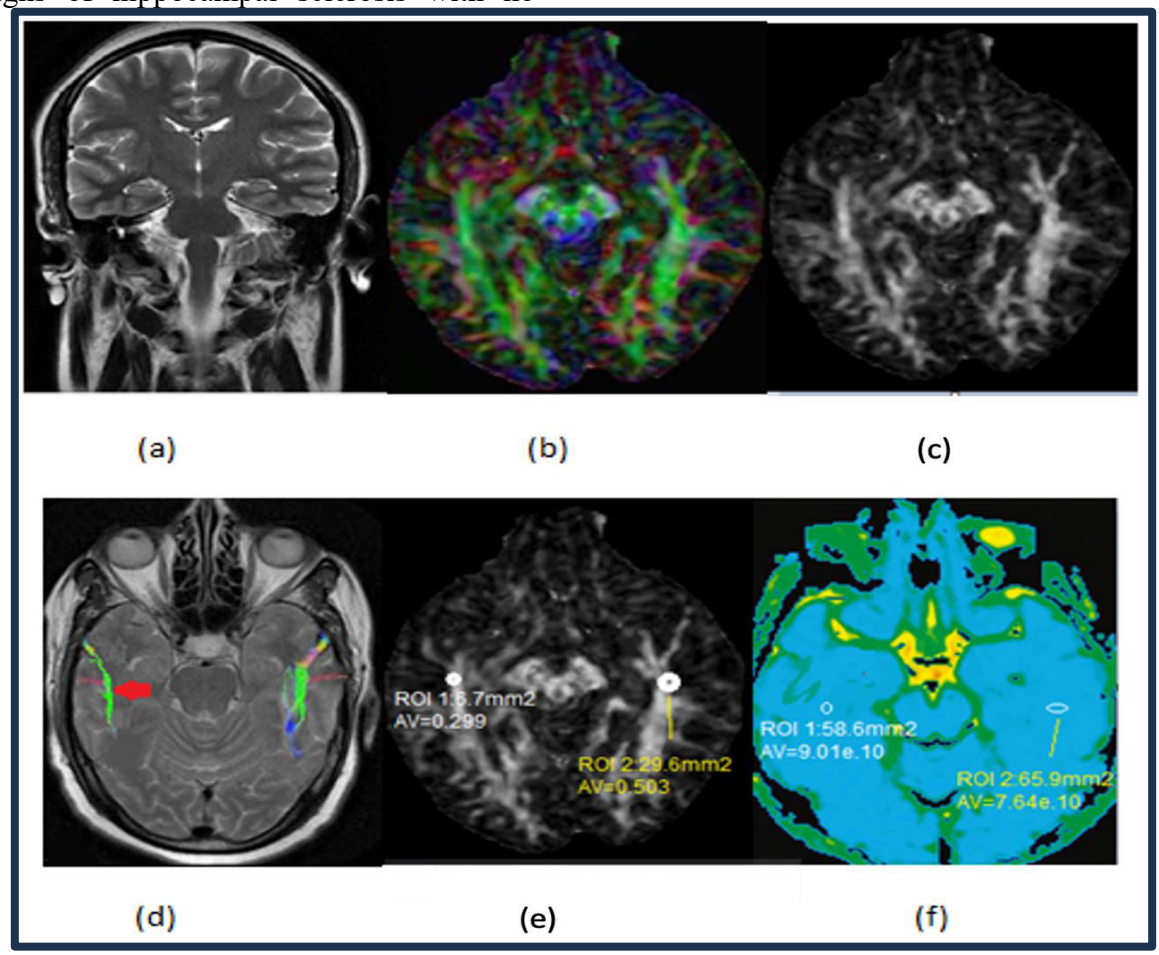

Fig.3. (a) Coronal T2 MRI image shows no signs of hippocampal sclerosis with no evidence of temporal lobes lesions (-ve MRI). (b) Axial color FA map shows decreased color hue of tracts of both temporal lobes, the color code reveals the fiber direction; red = left to right, blue = cranio-caudal, and green = anterior-posterior. (c) Axial FA map reveals decreased intensity of both temporal lobes. (d) Axial 2 D tractography image shows both ILF with decreased color hue on Rt side (arrow) (e) Axial FA map reveals measurement of FA at temporal lobes on both sides = 0.299 on Rt side while 0.503 on Lt

side, FA difference = 0.204. (f) Axial color ADC map shows measurement of ADC at temporal lobes on both sides = 9.01e.10 on Rt side while 7.64e.10 on Lt side

Case 4: A 11-year-old female patient, presented with seizure started when she was 1 years old. Her diagnosis of temporal lobe epilepsy was based primarily on clinical observations. EEG: revealed Lt temporal epileptogenic dysfunction. Conventional MR: showed no signs of hippocampal sclerosis with no evidence of temporal lobes lesions (-ve MR).

Post processing DTI revealed decreased FA and increased ADC of tracts of Lt temporal lobes with severely increased FA difference between both sides. This denoting positive affection of Lt side mismatching with conventional MR findings. (**Fig.4).**

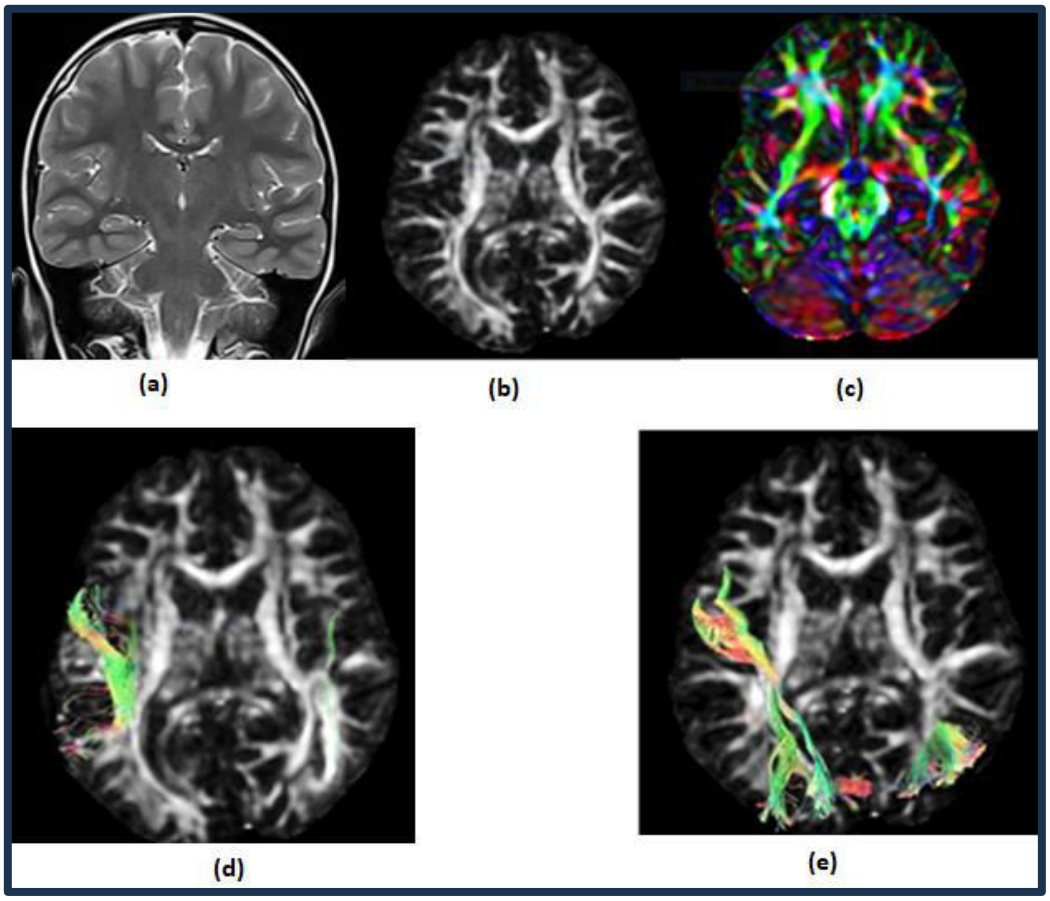

Fig.4. (a) Coronal T2 MRI revealed no signs of hippocampal sclerosis or lesions in both temporal lobes (b) FA map (c) Axial color map (d) Arcuate fasciculus with measuring FA on Lt side 0.409 while on Rt side 0.630, FA difference between both sides 0.221(e) Inferior longitudinal fasciculus with measuring FA on Lt side 0.389 while on Rt side 0.650, FA difference between both sides 0.261.

Discussion

The current study found that the patient group had lower FA in the arcuate fasciculi, IFOF, ILF, and uncinate fasciculi of both temporal lobes compared to the control group. This provides lateralizing evidence that the reduced FA is caused by epilepsy. This confirms what Salehi et al. **(Salehi et al., 2017)** found in their study of TLE patients. The seizure focus was lateralized using DTI data (ADC and FA). They found the ADC and the FA were

significantly increased and decreased, respectively in epileptogenic foci allowing its lateralization.

A comparable investigation was conducted by Zhao et al. **(Zhao et al., 2019)**, who compared 14 healthy participants with 14 patients with mesial temporal lobe epilepsy (MTLE). This study aligns with our current findings. Using symmetrical-voxel sampling regions of the anterior HF, MD and FA were calculated in every instance. Groups were compared based on their MD and FA values. While no statistically significant differences were observed among FA measures, they did find that MD was substantially higher in the HF ipsilateral to the lesion in the patient group when compared to the contralateral HF and healthy participants. Nonetheless, as contrasted with the healthy group, the sick group had substantially lower FA of both hippocampus. This could be explained by the inclusion of a larger number of participants. Reduced FA might be an indication that the pathogenic event took place in the temporal lobe, causing both an increase in diffusivity due to extracellular space expansion and a disturbance in the structure of the fiber bundle.

When we compared the DTI results with those from traditional MRI, we discovered that all 26 individuals who tested positive for organic causes or mesial temporal sclerosis on conventional MRI also tested positive on DTI. Moreover, DTI detected a hippocampal abnormality in 14 patients whose conventional MRI images were negative. This reflects the higher sensitivity of DTI in detecting diffusion abnormalities of hippocampi which consequently allows early detection of hippocampal pathological changes before becoming manifest on conventional MRI.

The amount of FA reduction was positively correlated with the duration of illness, which was statistically significant. This illustrates that the increase in disease duration leads to more neuronal loss and axonal disruption. According to Cruces and Concha **(Rodríguez-Cruces and Concha, 2015)**, axonal density (increased extra-axonal space) is a result of smaller-calibre axons and abnormalities in the myelin sheaths of surviving axons. This leads to a decrease in FA, which is seen in many white matter bundles of TLE patients. Chiang et al. **(Chiang et al., 2016)** examined the structural integrity changes that occur over a prolonged period of disease. They discovered that the duration of epilepsy was correlated with an increase in MD, suggesting that the structural integrity may undergo progressive alterations throughout the course of the disease.

A positive correlation was also found between the seizure frequency and the degree of FA reduction. Though this positive correlation did not reach a statistical significance, it might also reflect that more frequent seizures lead to more neuronal damage. A negative correlation was detected between the age of onset of seizure and FA reduction. This could be due to the increased vulnerability of the immature neurons to the damaging effect of the abnormal discharges. However, this inverse relationship does not reach statistical significance.

Oguz et al. **(Oguz et al., 2013)** carried out a study on 35 patients with MTLE and 36 healthy volunteers. This investigation evaluated the relationship between the presence of diffusion abnormalities and specific clinical variables, such as the duration of epilepsy, age at onset, and the frequency of generalized tonic-clonic seizures or partial complex seizures. None of these variables were found to be associated with the presence of diffusion anomalies. This contrasts with our investigation, which demonstrated that the diminution of FAs was positively correlated with the duration of the disease and seizure frequency, while it was negatively correlated with the age of onset. This may be due to methodological differences, as we studied a larger number

of patients with more variable ages of onset, disease duration, and seizures frequency.

Several investigations have demonstrated that diffusion changes in TLE are not restricted to the hippocampal region, but rather extend to the temporal and extratemporal white matter. Oguz et al. **(Oguz et al., 2013)** assessed MD and FA values in the white matter of the temporal lobe and extratemporal regions, as well as in the hippocampi. They identified an increase in diffusivity in the epileptic hippocampus and ipsilateral temporal structures, which was linked to a reduction in FA along the temporal lobe. Conversely, they observed that the contralateral non-sclerotic hippocampus, amygdala, and temporal pole exhibited reduced diffusivity. Finally, they noticed reduced FA in posterior extratemporal areas ipsilaterally. These results suggest that diffusion issues are not exclusive to the diseased hippocampus, but rather impact a more extensive network. This pattern may be interpreted as either a cause or effect of epilepsy and may indirectly represent the epileptogenic network.

In the present investigation, 11 patients who were enrolled exhibited organic lesions in the temporal lobe. Our demonstration of the impact of those lesions on the white matter tracts was conducted using the MRI tractography technique. The patterns of white matter tracts affection included edema of the tracts by a mass lesion in 1 patient, displacement of the tracts by a mass lesion in 2 patients, infiltration of the tracts by a mass lesion in 4 cases and destruction of the tracts by a mass lesion in 4 cases. Various studies are conducted to illustrate the impact of various lesions on the cerebral white matter, particularly in the context of brain tumors. Iliescu et al. **(Iliescu et al., 2011)** evaluated the role of MRI tractography in the assessment of cerebral white matter in cases of brain lesions. Conventional MRI was conducted both before and after contrast injection, and DTI and tractography of multiple white matter pathways in close proximity to the tumor were subsequently conducted. The contralateral normal, unaffected tract was compared to the results obtained. Displacement, infiltration, disruption, or edema were the characteristics of white matter involvement by a tumor, which is consistent with our observations.

The discrepancy in the results of our study may be attributed to the number of cases included, their nationality, the age of the patients, the MRI device used (1.5T vs 3T), or combined lesional and non-lesional cases.

Study limitations: Technical limitations such as inability to assess the MD index (as it is not included in the software of our MR machine) and the unavailability of 3T device in our institution. Other limitations were methodological in terms of small sample size, limited number of cases with organic lesions and inability to follow up the cases after surgical treatment.

Conclusion

DTI parameters and MRI tractography are novel structural imaging techniques that have the potential to provide sensitive markers for the early identification and lateralization of hippocampal abnormalities in TLE patients, particularly in those with negative conventional MRI imaging. The pre-surgical evaluation of patients with refractory epilepsy may be facilitated by its function in the lateralization of the epileptogenic region. Additionally, the MRI tractography technique can be beneficial in evaluating the impact of epilepsy on the cerebral white matter and tracts remote from the lesion, particularly in patients with TLE induced by a lesion.

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Conflict of Interest: Nil

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