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# A Study On Magnetic Resonance Imaging Evaluation Of Hippocampus With T2 Relaxation Time.

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**ABSTRACT**

The principal MRI features of hippocampal sclerosis are volume loss and increased T2 weighted signal intensity. Minor and localised abnormalities may be overlooked without careful quantitation. Hippocampal T2 relaxation time (HT2) can be quantified, but previously has only been measured on a few thick coronal slices with interslice gaps. The objective of the study is to acquire the data of hippocampal volumes (HV) and T2 relaxation times, to assess and compare qualitative and quantitative evaluations in determining hippocampi in patients with divergent durations of intractable epilepsy, and to initiate an imaging protocol based on the production of these techniques. The foremost magnetic resonance imaging (MRI) features of hippocampal sclerosis (HS) are volume loss and increased T2 weighted signal intensity. Minor abnormalities may be missed without careful quantitation. In this study, hippocampal T2 was calculated along the entire length of the hippocampus on adjacent slices and used, with quantitative measures of HV and distribution of atrophy, to better describe the range of HS. A total of 50 patients with temporal lobe epilepsy (TLE), 20 patients with extratemporal localization-related epilepsy and extratemporal lesions, and 30 control subjects were studied using MRI T2 relaxometry and volumetry. In controls and patients, HT2 was higher in the anterior than the posterior hippocampus. Patients with bilateral hippocampal involvement had an earlier onset of epilepsy than patients with unilateral HS. Calculation of regional abnormalities of hippocampal T2 relaxation along the length of the hippocampus gives the advance improvement to the MRI assessment of the hippocampi in patients with TLE and is corresponding to the volumetric and morphological data.

**Keywords:** Epilepsy, Seizure disorder, Imaging hippocampus, Magnetic resonance imaging, hippocampus, T2 relaxation time.

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## INTRODUCTION

Hippocampal sclerosis (HS) is the most recurrent pathologic condition underlying intractable temporal lobe epilepsy (TLE). Epilepsy is a known neurological disease specified by repeated seizures. Even though epilepsy is well manageable with antiepileptic drugs, there still exist about 30% of epilepsy patients who are not responding to optimal treatment [1]. The majority of the patients have better results after surgery, and this constantly determined by the presurgical assessment by electroencephalography and magnetic resonance imaging (MRI) Mesial temporal sclerosis (MTS) is a specific pattern of 39 hippocampal neuronal loss accompanied by gliosis and atrophy. The etiology is unknown, but there is a relationship between MTS and prolonged febrile seizures earlier in life, complicated delivery and developmental processes [2]. In 15% of patients another developmental abnormality can be found, mostly focal cortical dysplasia. This is called dual pathology. MTS is the most common cause of partial complex epilepsy in adults and is also the most common etiology in young adult patients undergoing surgery. Surgical removal of visible MRI changes associated with unilateral MTS leads to seizure freedom in up to 80% of cases [3]. Hippocampal volume loss is a sensitive and specific pointer of hippocampal sclerosis in the clinical setting of epilepsy, and hippocampal volumetric study can quantify atrophy in TLE patients. T2 relaxometry is another quantitative technique to determine the frequency and severity of T2 abnormality. Hippocampal T2 relaxation time increases in patient of hippocampal sclerosis. Mesial temporal sclerosis (MTS) is the most commonly known pathologic substrate of epilepsy [4]. Tissue hydration is quantified via T2 relaxometry4 and hippocampal atrophy is quantified via hippocampal volumetry. The most common radiologic manifestation of MTS seen in clinical practice is a unilateral atrophic hippocampus with increased signal, with a normal appearing contralateral hippocampus [5]. The surgical approach to temporal lobe epilepsy (temporal lobectomy) is also driven by the concept that MTS is a unilateral phenomenon. However, autopsy studies and, more recently, quantitative MR studies (volumetry and T2 relaxometry) indicate that MTS is present bilaterally in a substantial percentage of patients with temporal lobe– onset seizures [6]. For the sake of illustration, the entire spectrum of MTS can be divided into four possible conceptual categories : (a) unilateral hippocampal damage, in which MTS is present unilaterally, and the contralateral hippocampus is completely normal, (b) bilaterally asymmetric damage, in which MTS is present bilaterally, but is more severely represented on one side, (c) bilaterally symmetric damage, in which MTS is present and of equivalent magnitude in both hippocampi, and (d) symmetric normal hippocampi, in which neither hippocampus has changes of MTS. This fourth category is conceptually useful in the context of this discussion, because distinguishing mild MTS from a normal hippocampus is often not straightforward, either with MR imaging or with qualitative pathologic analysis. These four groups represent conceptual points along a continuous distribution of hippocampal damage ranging from normal to severe MTS in one or both hippocampi [7]. Most cases of MTS encountered for presurgical evaluation in general clinical practice will have hippocampal atrophy, increased signal, or, more commonly, both7–11. The accuracy of visual inspection of an appropriately. Performed MR examination in the setting of clear unilateral MTS exceeds 90% [8-10].

## MATERIALS AND METHODS

MRI images of 50 patients with the age group of 18-65 years from January 2020 to May 2021 retrospective analysis with clinical suspicion of HS and with the history of epilepsy from Department Of Radio diagnosis , Government Royapettah Hospital ,Kilpauk Medical College,Tamilnadu India were included in the study. An informed consent was obtained from the participating subjects. The patients referred to MRI brain were imaged in GE Signa 1.5 HDxt scanner with the routine brain protocol with an add up sequence of T2 multi-echo sequence with 16 echoes for the evaluation of the HS. The images obtained were subjected to radiological analysis and interpretation.

### Inclusion criteria

- Patients who have epilepsy,
- Patients with the history epilepsy and other neurological disorders.

### Exclusion criteria

- Patients with any H/O metallic implants,
- Patients with known cardiac pacemaker,
- Pregnant women,

- Claustrophobic patients.

## RESULTS

We had included 50 patients for this research after getting informed consent. Out of 50 patients, T2 multi-echo sequence identified hippocampal defects in 12-14 patients. Hence, routine sequences of the brain in MRI with an add up sequence T2 multi-echo sequence is better for detectionof major hippocampal defects in brain. For dedicated hippocampal study, inversion recovery (IR) oblique coronal images and oblique coronal T2W images (TR 5470, TE: 90, FOV: 200, slice thickness 2 mm) covering the whole brain were acquired. Oblique coronal plane was perpendicular to the long axis of hippocampus. The images were assessed for hippocampal atrophy, loss of defined morphologic structure of hippocampus, increased T2W signal and decreased T1W signal and a T2 relaxometry sequence is done to assess the T2 relaxation time of hippocampus using 16 - echo sequence. All the patients' data within the study period were collected. Patients were selected irrespective of their age group, gender and pathologic findings excluded from the study. T2 relaxometry values of the bilateral hippocampus for all the 30 patients were collected and analyzed.

**Image 1: T2-weighted and fluid attenuated inversion recovery images are the most sensitive for detecting mesial temporal sclerosis. The high signal in the hippocampus reflects gliosis**

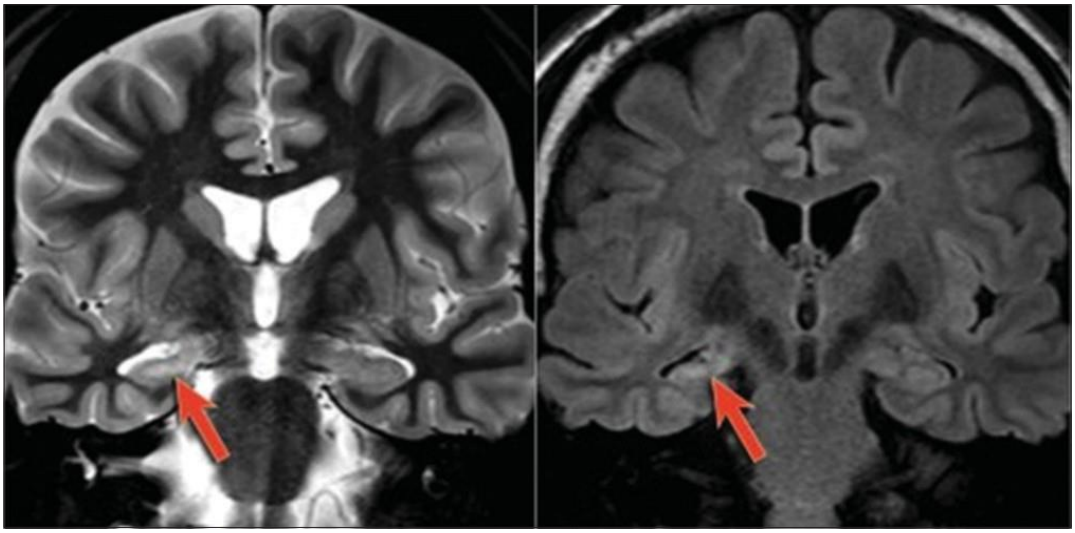

**Image 2: Dual pathology: Mesial temporal sclerosis and focal cortical dysplasia Images show mesial temporal sclerosis with a hyperintense and shrunken hippocampus (Red arrows), and secondary enlargement of the left temporal horn of the left laterale ventricle**

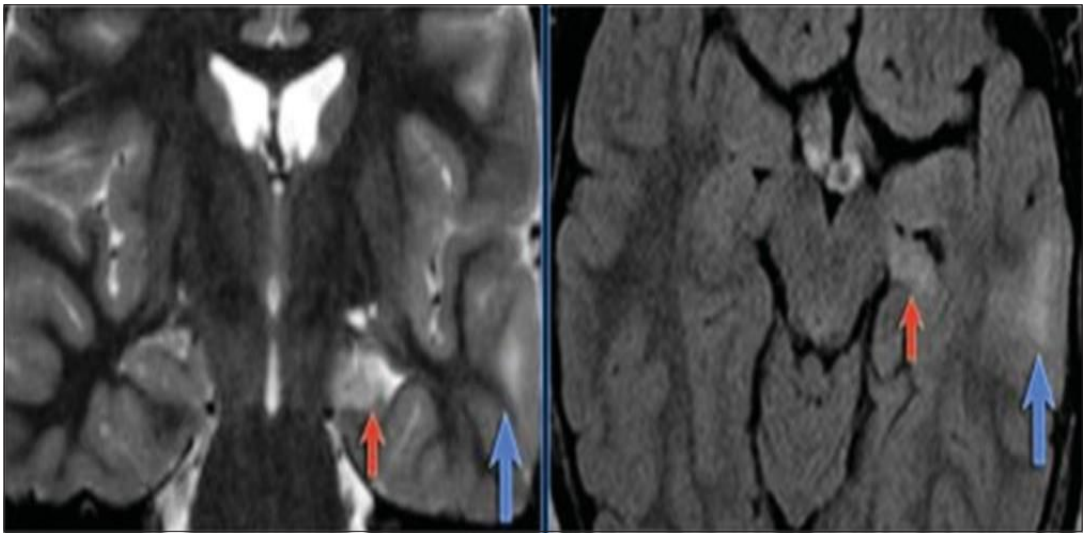

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**Image 3: Left mesial temporal sclerosis. Subtle gliosis of left hippocampus (Blue arrow) and atrophy (Yellow arrow)**

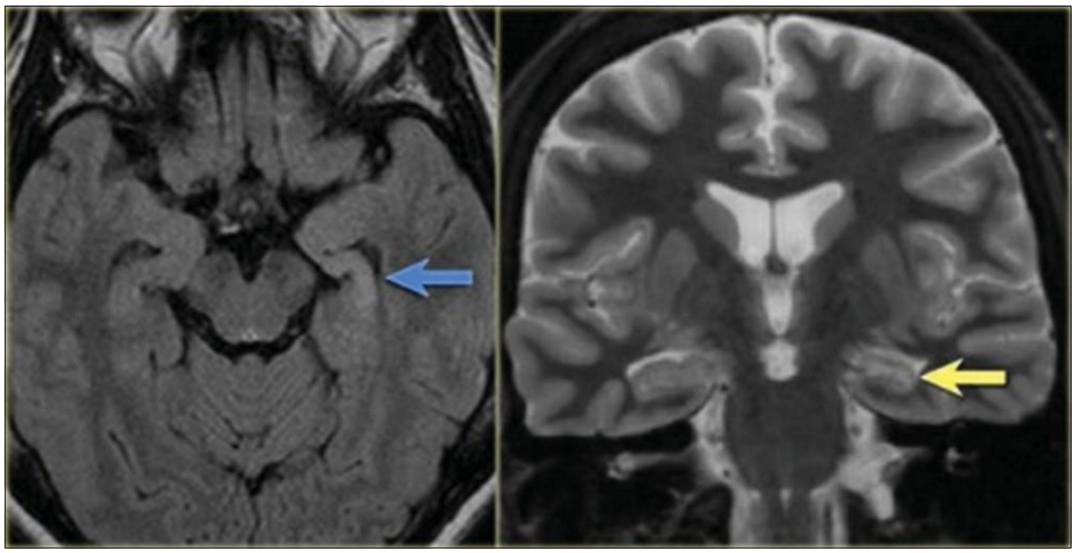
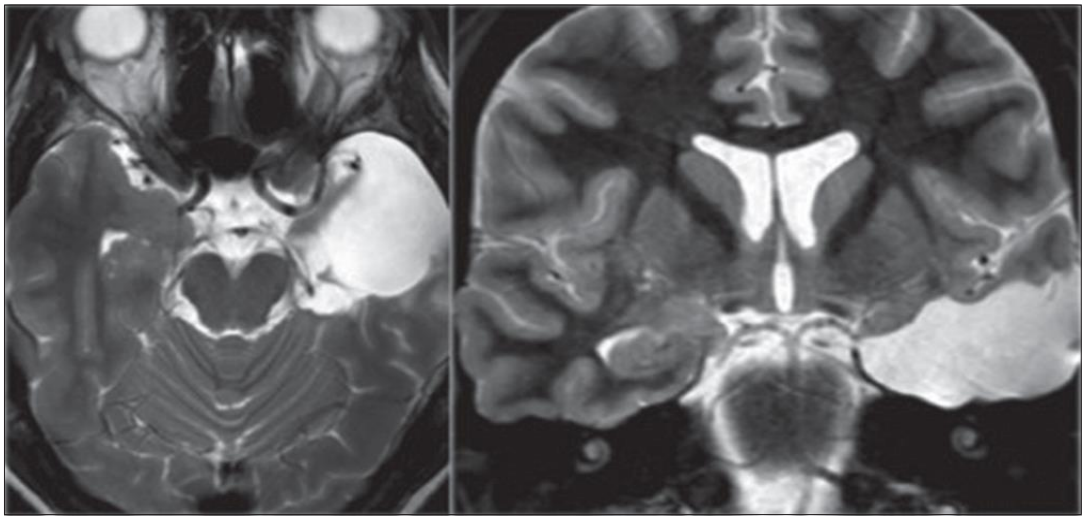


**Image 4 :Left mesial temporal sclerosis treated with the amygdalo - hyppocampectomy**



## DISCUSSION

The use of magnetic resonance imaging (MRI) as a quantitative tool has attracted great interest by various research centers. The improvement in the sensitivity and reduction of the subjectivity of visual evaluation created a osis of tissue abnormalities [11]. The most common MRI techniques for quantitative diagnosis at the lesion level are Relaxometry (R), Magnetization Transfer (MT) and Spectroscopy (MRS). However, one important issue is standardizing a calibrating protocol to be used in different scanners that is imperative to allow the use of MRI as a quantitative tool [12]. Epilepsy is a familiar neurological disease characterized by recurrent seizures. Even though epilepsy is presently generally well manageable with modern antiepile drugs, there still remain about 30% of patients with epilepsy who do not respond to optimal treatment patients are then understood to have intractable or medically refractory epilepsy [13]. Most of the patients have had good outcomes after surgery, and this regularly depends on the presurgical evaluation by EEG and magnetic resonance imaging (MRI). Unilateral hippocampal sclerosis (HS) is the most frequent pathological finding in temporal lobe epilepsy (TLE), and up to 65% of cases of TLE can be attributed to pathology arising entirely in the hippocampus.Coronal T2-weighted (T2W) and fluid attenuated inversion recovery (FLAIR) images are the most sensitive for detecting MTS [14]. On axial slices MTS is commonly overlooked. Bilateral MTS is difficult to detect due to the lack of comparison with the unaffected contralateral hippocampus. Notice the volume loss, which indicates atrophy and causes

secondary enlargement of the temporal horn of the lateral ventricle. The high signal in the hippocampus reflects gliosis.Mesial temporal sclerosis may occur in association with other pathology, especially focal cortical dysplasia. This is called dual pathology (Image 1).The images show MTS with a hyperintense and shrunken hippocampus (Red arrows), and secondary enlargement of the left temporal horn of the left laterale ventricle (Image :2 ).Also notice associated subcortical hyper intensity in the left temporal lobe indicating focal cortical dysplasia [15]. A 35-year-old patient with refractory TLE was included in the study. MR shows subtle hyperintensity of the left hippocampus on the axial FLAIR (Blue arrow) and atrophy. of the left hippocampus on coronal images (Yellow arrow) (Image :3).Hippocampus hyperintensity on T2W imaging or FLAIR images with volume loss is diagnostic for MTS in the appropriate clinical setting (Image :4 ). As with the multiecho technique, the dualecho sequences may be placed in any orientation as well as orthogonal to the hippocampus from a sagittal scout image [16]. The 30,120 dualecho sequence appeared to have advantages over the 30,80 sequence. Principally, there was superior test-retest and interrater reliability on assessments of a single data set and on repeated acquisitions from a subject. As expected, lower estimates of T2 were obtained from studies of test objects and in vivo measurements of hippocampal T2 relaxation times using the dual-echo CSE sequences rather than the 16-echo sequence with a fitted curve. This was not a concern, as the clinical requirement was to be able to distinguish normal from abnormal hippocampal T2 relaxation times reliably, and accurate absolute quantitation was not an issue. The CSE dual-echo sequence has several advantages over the previously used 16-echo sequence. The images obtained (echo times of 30 and 120) were highly satisfactory to neuroimaging specialists for the purposes of qualitative reporting and could be incorporated into a standard imaging protocol without the need for additional sequences [17]. Further, 5-mm-thick sections have produced reliable data, minimizing partial volume effects; with the multiecho sequence, 8-mm-thick sections were found to give optimal quantitation of hippocampal T2 relaxation times. Additionally, by using the CSE dual-echo sequences, it is possible to get complete coverage of the hippocampus and brain with contiguous 5-mm-thick sections collected in two interleaved acquisitions [18]. In contrast, the multiecho sequence gave only a single hippocampal section. Complete coverage in 5-mm-thick sections allows for correction of misalignment of the patient in the scanner and also permits the construction of a profile of T2 values throughout the length of the hippocampus, analogous to the profiles of cross-sectional areas that may be derived from volumetric data [19]. We are in the process of conducting a comparative study of these profiles to define better the spectrum of hippocampal sclerosis. MR findings, 46 cases (92.59%) showed increased T2 relaxometry values and 2 cases (7.41%) showed normal T2 relaxometry values. All three cases with negative findings on MR visual analysis showed increased T2 relaxometry values. The T2 relaxometry values were raised on side of epileptogenic origin and mean values were 126.16 ± 6.49 ms in right MTS and 124.01 ± 11.71 ms in left MTS cases. Overall, T2 relaxometry exhibited a sensitivity of 90%, specificity of 93.3 percent, positive predictive value (PPV) of 93.1 percent, negative predictive value (NPV) of 90.32 percent, and diagnostic accuracy of 91.6 percent [20].

## CONCLUSION

Right and left hippocampal volumes are positively correlated, and right hippocampal volume is larger than left by a statistically insignificant amount. No significant correlation of hippocampal volumes and T2 relaxation times exists with gender or age. Patients with intractable temporal lobe epilepsy have smaller mean hippocampal volume and longer T2 relaxation time ipsilateral to seizure focus. Calculation of regional abnormalities of hippocampal T2 relaxation along the length of the hippocampus gives the advance improvement to the MRI assessment of the hippocampi in patients with TLE and is corresponding to the volumetric and morphological data.

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