

# Multiple Sclerosis, Corpus Callosum & Epilepsy

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**Abstract:**

There is a difference in prevalence of Epilepsy in General population & MS patients. Interictal Epileptiform Discharges (IED) positivity in EEG is also different in the above two populations. Demyelination slows down the conduction speed of axons and author is proposing that different speed of conduction in adjacent axons can generate re-entrant circuits. If the reentrant circuits involve Corpus callosum (CC) fibers, seizure activities of MS can be triggered. DBS applied to CC can terminate the seizure attack of MS like Vagal Nerve Simulator (VNS) in terminating seizure in general population.

**Keywords:** multiple sclerosis; epilepsy; corpus callosum; re-entrant circuit

**Abbreviations:**

AV= Atrioventricular, CC= Corpus callosum, DBS= Deep Brain Stimulation, IED= Interictal Epileptiform Discharge, REC= Re-entrant circuit, SVT = Supraventricular tachycardia, VNS= Vagal Nerve Stimulator, VICS= Variation in conduction speed

**Introduction:**

**Epilepsy in general population:**

The prevalence of epilepsy in general population is 0.97% (Joint Epilepsy Council of the UK and Ireland 2011). Standard investigation for Epilepsy is EEG, looking for IEDs but only in about one third of epileptic patients showed IEDs on EEG.

**Epilepsy in MS sufferers:**

According to my experience, the prevalence of Epilepsy in Multiple Sclerosis population is around 4% and EEG in this population does not show IEDs.

The comparison between the two populations is described in Table 1,

|                        | MS patients         | General population |
|------------------------|---------------------|--------------------|
| Prevalence of Epilepsy | 4%                  | 0.9%               |
| IED positivity in EEG  | ~33%                | 0%                 |
| MRI Brain scan         | Normal CC thickness | Thinning of CC     |
| Treatment              | AED, GA             | AED, GA, DBS       |

**Abbreviations:**

AED= Antiepileptic drug, CC= Corpus Callosum, DBS= Deep Brain Stimulation, EEG= Electroencephalogram, GA= General anesthesia, IED= Interictal Epileptiform Discharge, MS =.Multiple Sclerosis,

**Table 1:** Comparison between Epilepsy in General Population & MS sufferers

**Materials and methods:**

To propose a concept that can explain the difference in prevalence between general population and MS patients

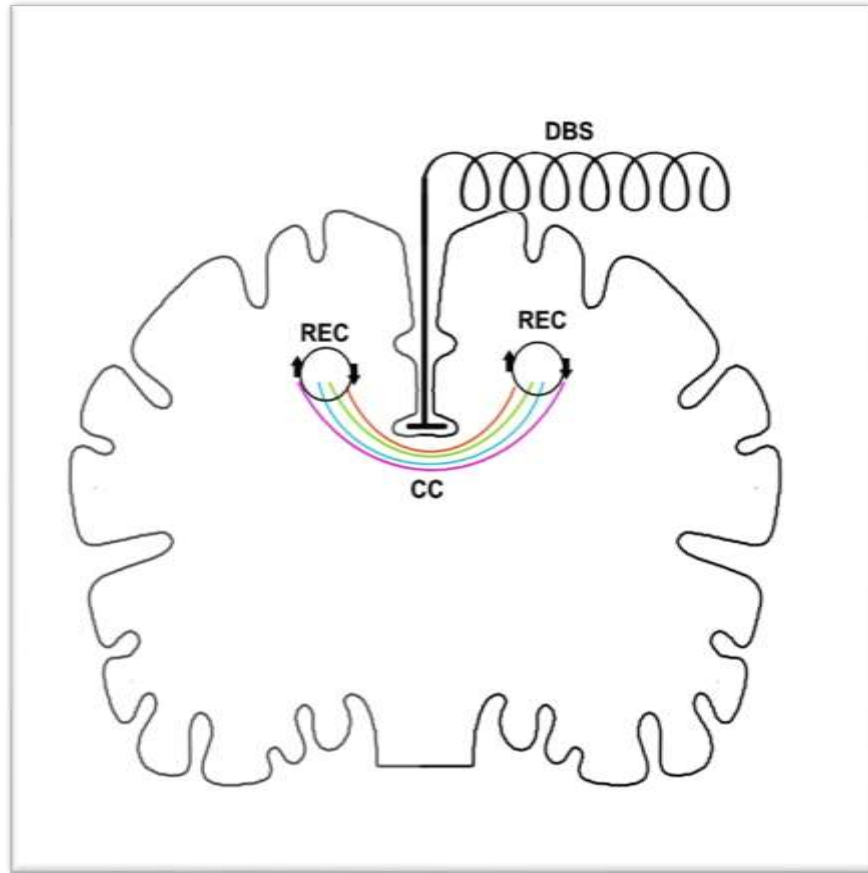
**Results and Discussion:**

In MS, it is the white matter axons that are affected by demyelination. As we all know, demyelination slows down the conduction speed in the axons. The speed of conduction in axons will vary depending on the

extent of demyelination in the axons. This will result in variations in conduction speed (VICS). VICS can create Re-entrant circuits (REC). It is like in Atrio-ventricular re-entrant circuits of AV conduction bundle in the heart. The RECs in AV conduction bundle can trigger Paroxysmal SVTs and can even lead to Cardiac arrest.

In the brain, the CC (containing millions of axons) connects the two sides of the brain and the conduction is in both directions. It is the most likely

potential point where re-entrant circuits can occur if there is VICS in the axons (Figure 1).



**Abbreviations:**

CC= Corpus Callosum, DBS= Deep Brain Stimulation, REC= Re-entrant circuit

**Figure 1:** Corpus Callosum, Re-entrant circuits and Deep Brain Stimulation

The comparison between RECs in AV node and CC is mentioned in Table 2.

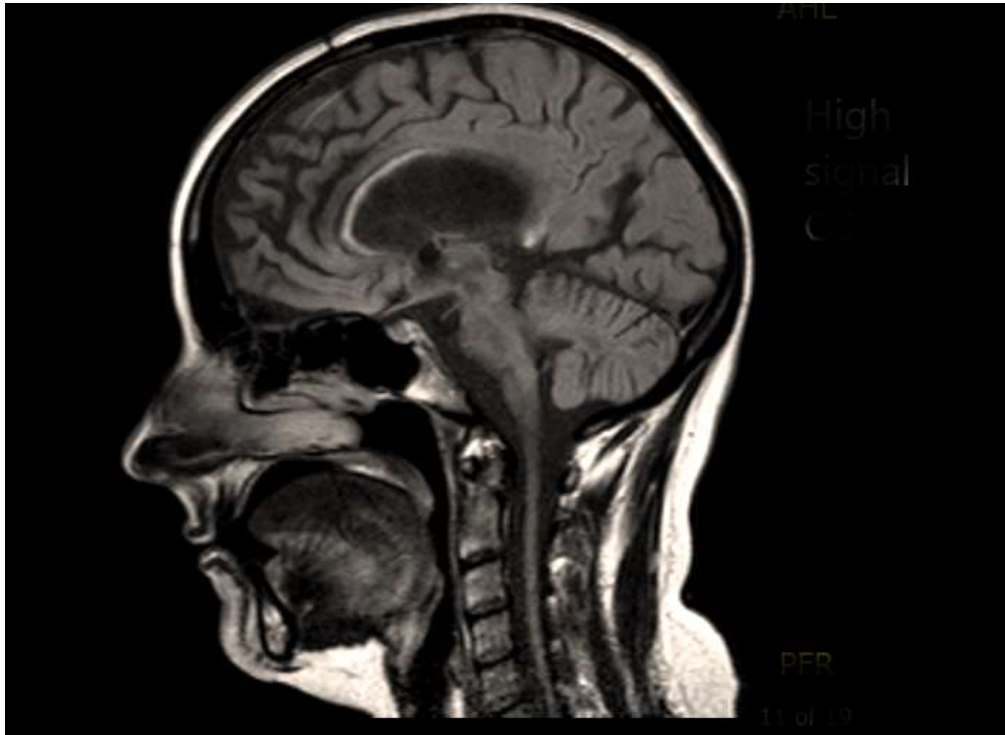
|               | <b>SVT</b>                                | <b>Seizure in MS patients</b>           |
|---------------|---|---|
| REC           | VICS between Normal & Accessory pathways  | VICS between CC fibers                  |
| Site of REC   | Between upper & lower halves of the heart | Between right & left sides of the brain |
| Treatment     | Adenosine, DC cardioversion               | AEDs, GA, DBS                           |
| Investigation | Electrophysiology                         | MRI Brain Scan (CC thinning)            |

**Abbreviations:**

AED= Antiepileptic drug, AV=Atrioventricular, CC= Corpus callosum, DC= Direct current, DBS=Deep Brain Stimulation, GA=General anesthesia, MRI= Magnetic Resonance Imaging, MS= Multiple sclerosis, REC= Re-entrant circuit, SVT= Supraventricular tachycardia, VICS= Variation in conduction speed,

**Table 2:** Comparison between Atrioventricular and Corpus Callosum Re-entrant circuits

The other significant finding in my experience is that all of MS patients with epilepsy were found to have significant thinning of the CC on MRI brain images. Thinning of the CC is the evidence that the demyelination process involves CC fibers (Figure 2).



*The scan showing significant thinning and high signal of Corpus Callosum in Multiple Sclerosis patient who started having seizures and EEG did not show Interictal Epileptiform discharges*

**Figure 2:** Mid-sagittal MRI Brain Scan

If this hypothesis is proven, Deep Brain Stimulation (DBS) applies to CC (Figure 1) could be a new treatment in terminating seizures in MS sufferers (like applying Vagal Nerve Stimulator in Epilepsy in general population). DBS to CC is like a temporary electrical Corpus callosotomy.

### Conclusion:

Demyelination can create VICS in axons. If the VICS axons are adjacent to one another, RECs can be created. If RECs involves CC axons, seizure activity can result. This is my proposed pathophysiology for epilepsy in MS. DBS applying to CC can be a promising intervention in terminating seizure activity of MS sufferers.

### Conflict of Interest

There is no conflict of interest.



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