

Introduction

Febrile seizures (FS) are seizure events occurring in children older than 1 month that are associated with a fever not caused by a central nervous system infection. They are the most common cause of seizures in children younger than 5 years of age. While most children with FS do not develop epilepsy. Simple FS is defined as a FS lasting less than 15 minutes and with no focality, while complex FS is defined as a seizure lasting longer than 15 minutes, focal manifestations, seizure recurrence in 24 hours^[1], abnormal neurologic examination findings, or history of afebrile seizures in a parent or sibling. One tool for quantitating myelin content is a novel imaging technique called mcDESOT (multicomponent-derived equilibrium single-pulse observation of T1 and T2). This quantitative magnetic resonance imaging (MRI) technique estimates myelin water fraction (MWF).^[2]

Patient and Methods

For this study, subjects with an initial diagnosis of FS for whom there were at least 10 months of follow-up clinical information were included. Patients were selected by first reviewing (MRI) orders which were placed at Rhode Island Hospital in pediatric patients for seizure work-up. The initial diagnosis was based on clinical, MRI and/or electroencephalography (EEG) data

Diagnosis

Seven subjects (3 male, 4 female) who initially presented with FS were included in this study. Three had simple seizures and four had complex seizures. The average age at time of MRI was 25.6±17.7 months. The time between first febrile seizure and the performance of the mcDESOT MRI sequence ranged between 11 days and 17 months for the 7 subjects.

Subject	Patient age	Patient sex	Seizure Type	MWF (p<0.05)*	MRI	EEG	Time from FS to MRI	F/U Length (months)	Epilepsy
1	11 mo	M	S	Increased	Normal	None	21d	61	N
2	2 yr	F	S	Increased	Normal	None	16d	24	N
3	3 yr	M	C	Decreased	Abnormal†	Abnormal	17mo	13	Y
4	5 yr	F	S	Increased	Normal	None	11d	55	N
5	1 yr	M	C	Decreased	Normal	Abnormal	43d	46	Y
6	2 yr	F	C	Decreased	Abnormal^	Abnormal	11d	16	N
7	1 yr	F	C	Decreased	Normal	Abnormal	28d	10	N

Table 1: Study patient characteristics and results

F/U = follow-up; S = simple; C = complex

*MWF is reported as higher or lower when compared to an age-matched control.

†Left hippocampal dysplasia

^ Possible left parietal focal cortical dysplasia

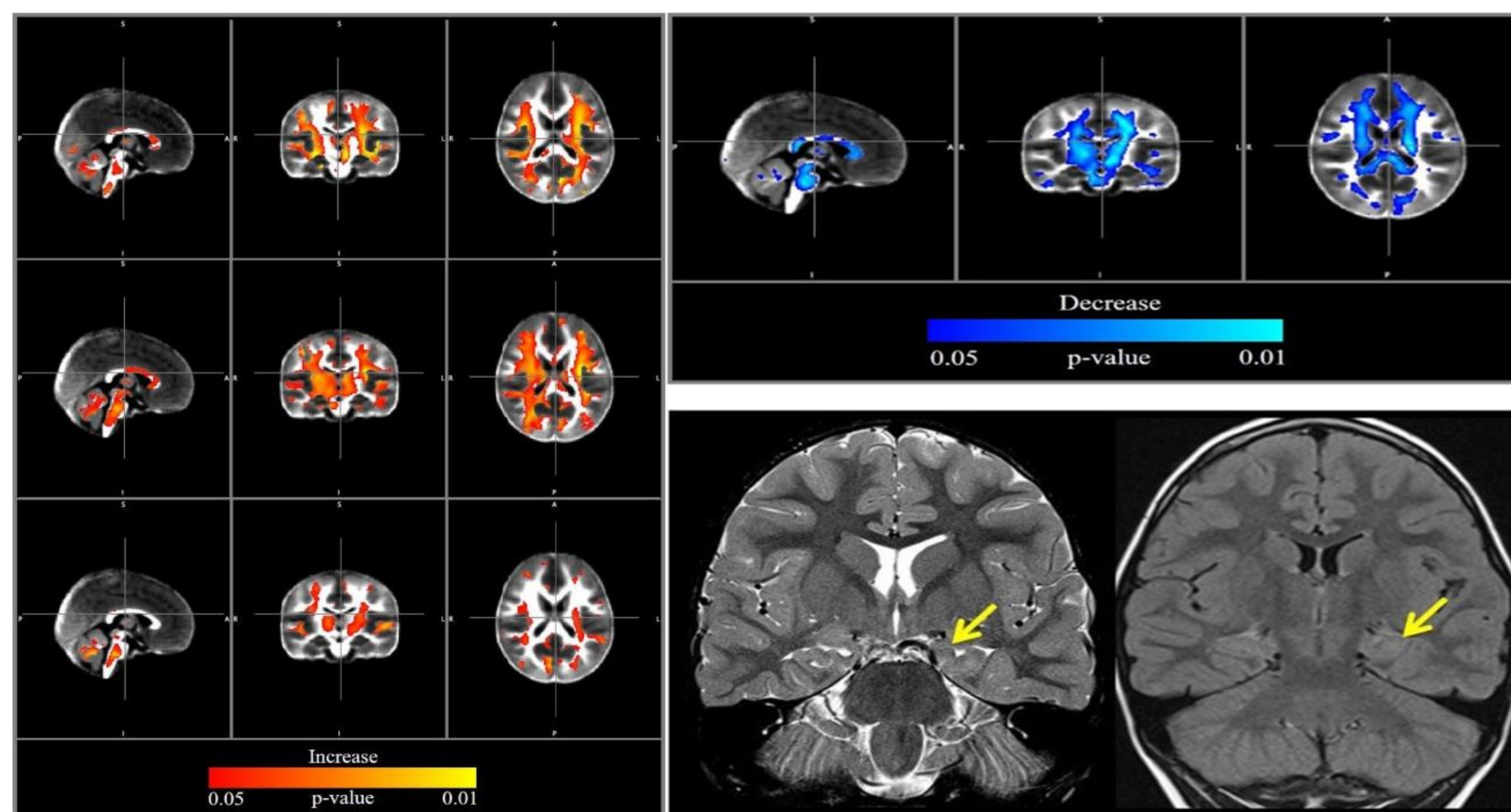


Figure 1. Sagittal (left), coronal (center), and axial (right) MWF maps in subjects #1 (top), #2 (middle), and #4 (bottom) showing areas of higher MWF (in red) compared with control model.

Figure 2. MWF maps of this subject showing areas of lower MWF compared with control model. Bottom T2-weighted and FLAIR MRI images of this subject showing mild left hippocampal dysplasia with a foreshortened left hippocampus and vertically oriented parahippocampal gyrus.

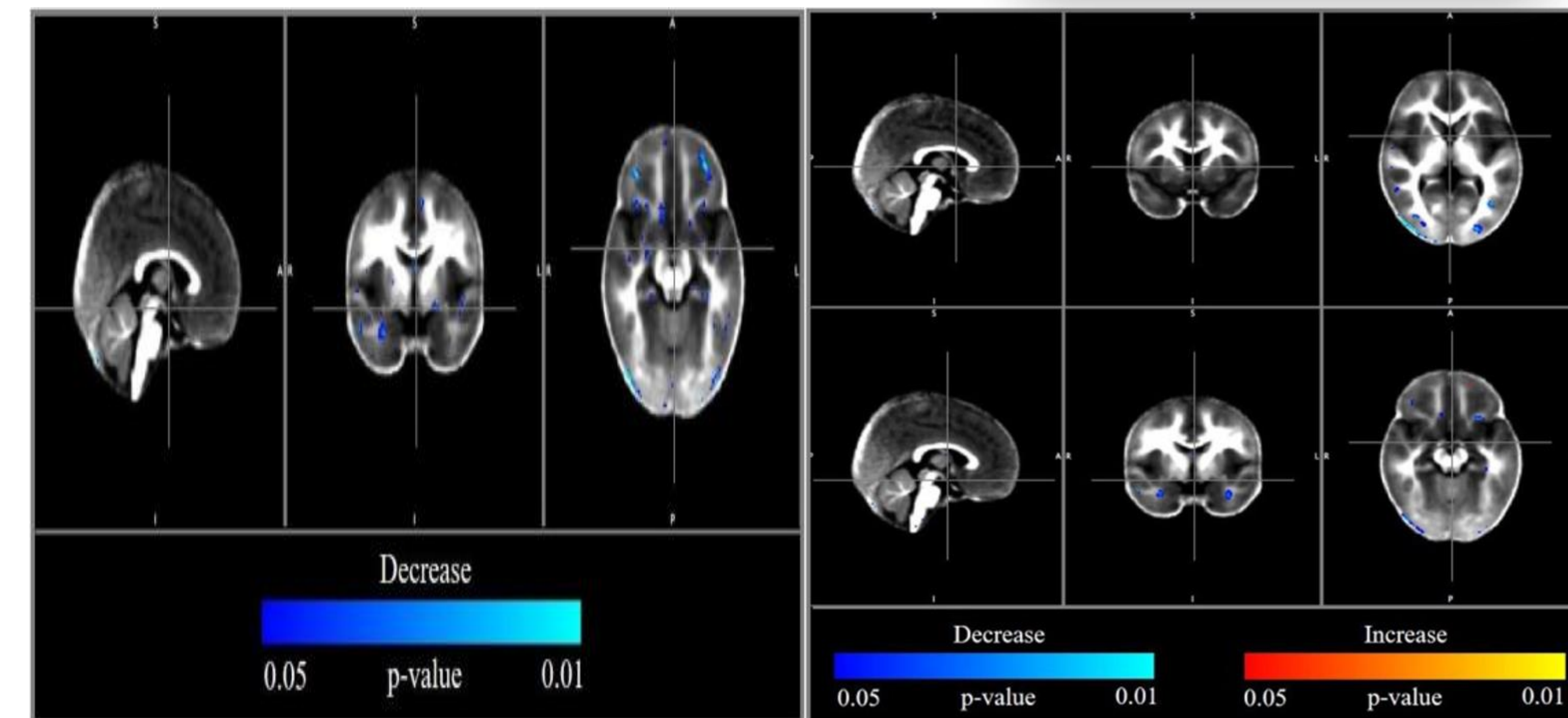


Figure 3. MWF maps of this subject showing areas of lower MWF (in blue) showing scattered areas of decreased compared with control model. The subject MWF (in blue) compared with control progressed to develop epilepsy.

Figure 4. MWF maps of this subject and showing areas of lower MWF (in blue) compared with control model. These two subjects did not progress to epilepsy.

Discussion

The study obtained MWF maps in pediatric subjects presenting with FS to compare their myelination patterns with those of model-derived controls. Of the seven participants, two developed epilepsy, and these subjects had significantly lower MWF when compared with their model-derived controls. Two subjects had slightly lower MWF than the control model, but they did not develop epilepsy. In comparison with those in the subjects who developed epilepsy, these reductions in MWF were observed in fewer areas. All subjects with lower MWFs had complex FS. The three subjects with relatively higher MWF than the model-derived control models had normal MRI scans and simple FS and did not develop epilepsy.

Conclusion

These results support the hypothesis that for children presenting with FS, lower MWF in comparison with a model-derived control may portend a higher risk of developing epilepsy later in life and higher MWF in comparison with a model-derived control may indicate a lower risk of development of epilepsy and simple FS.

References

- Gellis, S. and Kagan, B. (n.d.). *Current pediatric therapy*.
- Moldovan, K., Boxerman, J., O'Muircheartaigh, J., Dean, D., Eyerly-Webb, S., Cosgrove, G., Pucci, F., Deoni, S. and Spader, H. (2018). Myelin water fraction changes in febrile seizures. *Clinical Neurology and Neurosurgery*, [online] 175, pp.61-67. Available at: <http://10.1016/j.clineuro.2018.10.005> [Accessed 2 Dec. 2018].