SUMMARY

Epilepsy belongs to the most prevalent neurological disorders in pediatric patients. About 30% of the patients are refractory to conventional anti-epileptic drugs and many experience side effects such as sedation and cognitive impairment. The majority of patients suffer from complex partial seizures, which have been shown to originate in many cases in the mesial temporal lobe structures, particularly in the hippocampal-amygdaloid region.

Neuroimaging is an essential diagnostic tool for evaluating new-onset seizure disorders and chronic uncontrolled epilepsy.

Recent advances in Neuroimaging have enhanced the clinician's ability to identify the underlying causes of seizure disorders in many patients; thus, the appropriate medical or surgical therapy can be used.

Intractable pediatric epilepsy patients represent a challenging clinical population, although advances in Neuroimaging continue to improve diagnosis and treatment in these patients.

Patients with medically uncontrolled partial seizures are possible candidates for surgery so the seizure focus must be correctly lateralized. Electroencephalography EEG, video EEG , structural and metabolic imaging are used for lateralization.

Our study has shown that multimodality Neuroimaging plays an essential role in noninvasively localizing Epileptogenic foci for possible surgical resection.

REFERENCES

1. Abass Alavi . **PET: a revolution in medical imaging**, USA RSNA **2004.**
2. Achten E. **Aspects of proton MR spectroscopy in the seizure patients**. Neuroimaging clinics of N. Am. Nov. 8 (4): 849 – 862, **1998**.
3. Akhtari M, Salamon N, Duncan R, Fried I, et al. **Electrical conductivities of the freshly excised cerebral cortex in epilepsy surgery patients; correlation with pathology, seizure duration, and diffusion tensor imaging**. Brain Topogr **2006**; 18:281–290.
4. Alcantara S, Ruiz M, De Castro F, et al. **Netrin 1 acts as an attractive or as a repulsive cue for distinct migrating neurons during the development of the cerebellar system.** Development **2000**;127:1359–72.
5. Andrew B. Newberg, Abass Alavi. **PET in seizure disorders**, USA RSNA **2005**.
6. Arfanakis K, Hermann BP, Rogers BP, Carew JD, et al. **Diffusion tensor MRI in temporal lobe epilepsy**. Magn Reson Imaging **2002**; 20:511–519.
7. Arzimanoglou A, Aicardi J. T**he epilepsy of Sturge-Weber syndrome: clinical features and treatment in 23 patients**. Acta Neurol Scand Suppl **1992**;140:18–22.
8. Arzimanoglou AA, Andermann F, Aicardi J, et al. **Sturge-Weber syndrome: indications and results of surgery in 20 patients.** Neurology **2000**;55:1472–1479.
9. Assaf BA, Mohamed FB, Abou-Khaled KJ, Williams JM, et al. D**iffusion tensor imaging of the hippocampal formation in temporal lobe epilepsy**. AJNR Am J Neuroradiol **2003**; 24:1857–1862.

10. Bammer, R, Acar, B and Moseley, M E. **In vivo MR tractography using diffusion imaging**. Eur J Radiol, **2003**. 45(3): p. 223-34.
11. Barkovich AJ. **Pediatric neuroimaging**. 4th ed. Philadelphia: Lippincott Williams &Wilkins, **2005**.
12. Baron Y, Barkovich AJ. **MR imaging of tuberous sclerosis in neonates and young infants**. AJNR Am J Neuroradiol **1999**;20:907–916.
13. Basser, P J and Jones, D K. **Diffusion-tensor MRI: theory, experimental design and data analysis - a technical review**. NMR Biomed, **2002**. 15(7-8): p. 456-67.
14. Bergin PS, Fish DR, Shorvon SD, Oatridge A, deSouza NM, Bydder GM. **Magnetic resonance imaging in partial epilepsy: additional abnormalities shown with the fluid attenuated inversion recovery (FLAIR) pulse sequence**. J Neurol Neurosurg Psychiatry. **1995**;58:439-443.
15. Bertram, E H, Zhang, D X, Mangan, P, Fountain, N and Rempe, D. **Functional anatomy of limbic epilepsy: a proposal for central synchronization of a diffusely hyperexcitable network**. Epilepsy Res, **1998**. 32(1-2): p. 194-205.
16. Bien CG, Urbach H, Deckert M, et al. **Diagnosis and staging of Rasmussen's encephalitis by serial MRI and histopathology.** Neurology **2002**;58:250–257.
17. Bittles MA, Sidhu MK, Sze RW, Finn LS, et al. **Multidetector CT angiography of pediatric vascular malformations and emangiomas: utility of 3-D reformatting in differential diagnosis**. Pediatr Radiol **2005**; 35:1100–1106.
18. Blumcke I, Lobach M, Wolf HK, Wiestler OD. **Evidence for developmental precursor lesions in epilepsy-associated glioneuronal tumors**. Microsc Res Tech **1999**;46:53–58.

19. Bouillert V., Dupont S., Spelle L. et al., **Insular cortex involvement in mesiotemporal lobe epilepsy. A positron emission tomography study**. Ann Neurol. 51: 202-8, **2002**.

20. Bradley WG, Shey RB. **MR imaging evaluation of seizures**. Radiology **2000**.
21. Briellmann RS, Mitchell LA, Waites AB, et al. **Correlation between language organization and diffusion tensor abnormalities in refractory partial epilepsy**. Epilepsia **2003**; 44:1541–1545.
22. Bulakbasi N,Kocaoglu M, Ors F,Tayfun C,Ucoz T . **Combination of single-voxel proton MR spectroscopy and apparent diffusion coefficient calculation in the evaluation of common brain tumors**. AJNR Am J Neuroradiol **2003**.
23. Cascino GD, Jack CR, Jr., Parisi JE, et al. **Magnetic resonance imaging-based volume studies in temporal lobe epilepsy: pathological correlations**. Ann Neurol **1991**; 30:31–36.
24. Casino G.D, Elson L.S, Buchhalter J.R and Mullan B.P. **The current place of single photon emission computed tomography in epilepsy evaluation**. Neuro.Clin. of N. Am. 14: 553 – 561, **2004**.
25. Castillo M, Smith JK, Kwock L. **Proton MR spectroscopy in patients with acute temporal lobe seizures.** AJNR Am J Neuroradiol **2001**; 22:152-157.
26. Catani, M, Howard, R J, Pajevic, S and Jones, D K. **Virtual in vivo interactive dissection of white matter fasciculi in the human brain**. Neuroimage, **2002**. **17**(1): p. 77-94.
27. Cendes F, Andermann F, Gloor P, et al. **MRI volumetric measurement of amygdala and hippocampus in temporal lobe epilepsy.** Neurology;43:719–25. ,**1993**
28. Cendes F, Caramanos Z, Andermann F, Dubeau F, et al. **Proton magnetic resonance spectroscopic imaging and magnetic resonance imaging volumetry in the lateralization of temporal**

lobe epilepsy: a series of 100 patients. Ann Neurol **1997**; 42:737–746.

29. Cepeda C, Andre VM, Levine MS, et al. **Epileptogenesis in pediatric cortical dysplasia: the dysmature cerebral developmental hypothesis**. Epilepsy Behav **2006**;9:219–235.
30. Chabardés S., Kahane Ph., Minotti L. et al., **Anatomy of the temporal pole region.** *Epileptic disorders* Vol 4, supp. 1, S9 – S15 sept. **2002**.
31. Chandra PS, Salamon N, Huang J, et al. **FDG-PET/MRI coregistration and diffusion-tensor imaging distinguish epileptogenic tubers and cortex in patients with tuberous sclerosis complex: a preliminary report**. Epilepsia **2006**;47:1543–1549.
32. Chuang NA, Otsubo H, Pang EW, Chuang SH. **Pediatric magnetoencephalography and magnetic source imaging.** Neuroimaging Clin N Am **2006**; 16:193–210, ix–x.
33. Chuong C-M. **Differential roles of multiple adhesion molecules in cell migration: granule cell migration in cerebellum.** Experientia **1990**;46:892– 9.
34. Ciccarelli, O, Toosy, A T, Parker, G J, Wheeler-Kingshott, C A, Barker, G J, Miller, D H and Thompson, A J. **Diffusion tractography based group mapping of major white-matter pathways in the human brain**. Neuroimage, **2003**. 19(4): p. 1545-55.
35. Concha L, Beaulieu C, Gross DW. **Bilateral limbic diffusion abnormalities in unilateral temporal lobe epilepsy**. Ann Neurol **2005**; 57:188–196.
36. Concha L, Gross DW, Wheatley BM, Beaulieu C. **Diffusion tensor imaging of timedependent axonal and myelin degradation after corpus callosotomy in epilepsy patients.** Neuroimage **2006**; 32:1090–1099.

37. Connelly A, Van Paesschen W, Porter DA, Johnson CL, et al. **Proton magnetic resonance spectroscopy in MRI-negative temporal lobe epilepsy**. Neurology **1998**; 51:61–66.
38. Cook SW, Nguyen ST, Hu B, et al. **Cerebral hemispherectomy in pediatric patients with epilepsy: comparison of three techniques by pathological substrate in 115 patients**. J Neurosurg **2004**;100:125–141.
39. Cowan F, Rutherford M, Groenendaal F, et al. O**rigin and timing of brain lesions in term infants with neonatal encephalopathy**. Lancet **2003**;361:736–742.
40. Cross JH, Connelly A, Jackson GD, Johnson CL, et al. **Proton magnetic resonance spectroscopy in children with temporal lobe epilepsy.** Ann Neurol **1996**; 39:107–113.
41. Curatolo P. **Neurological manifestations of tuberous sclerosis complex**. Childs Nerv Syst **1996**;12:515–521.
42. David Y.K. Srivastane S.S. **Temporal lobe epilepsy**. Oct. **2001.**
43. Di Rocco C, Battaglia D, Pietrini D, Piastra M, Massimi L. **Hemimegalencephaly: clinical implications and surgical treatment.** Childs Nerv Syst **2006**;22:852–866.
44. Di Rocco C, Tamburrini G. S**turge-Weber syndrome.** Childs Nerv Syst **2006**;22:909–921.
45. Duc CO, Trabesinger AH, Weber OM, Meier D, et al. **Quantitative 1H MRS in the evaluation of mesial temporal lobe epilepsy in vivo.** Magn Reson Imaging **1998**; 16:969–979.
46. Duchowny MS. **Complex focal seizures of infancy**. Arch Neurol; 44:911–914. ,**1987**
47. Dumas de la Roque A, Oppenheim C, Chassoux F, Rodrigo S, et al. **Diffusion tensor imaging of partial intractable epilepsy.** Eur Radiol **2005**; 15:279–285.
48. Duncan J.S. **Neuroimaging methods to evaluate the etiology and consequences of epilepsy**. Epilepsy research 50, 131-140, **2002**.

49. Duzel E, Kaufmann J, Guderian S, Szentkuti A, et al. **Measures of hippocampal volumes, diffusion and 1H MRS metabolic abnormalities in temporal lobe epilepsy provide partially complementary information.** Eur J Neurol **2004**; 11:195–205.
50. Dyrby, T B, Sogaard, L V, Parker, G J, Alexander, D C, Lind, N M, Baare, W F, Hay-Schmidt, A, Eriksen, N, Pakkenberg, B, Paulson, O B and Jelsing, J. **Validation of in vitro probabilistic tractography**. Neuroimage, **2007**. 37(4): p. 1267-1277.
51. ELSON L. SO, **Role of Neuroimaging in the Management of Seizure Disorders**, Mayo Clin Proc. **2002**;77:1251-1264
52. Elster AD, Chen MY. **MR imaging of Sturge-Weber syndrome: role of gadopentetate dimeglumineand gradient-echo techniques**. AJNR Am J Neuroradiol **1990**;11:685–689.
53. Elster AD, Mirza W. **MR imaging in chronic partial epilepsy: role of contrast enhancement**. AJNR Am J Neuroradiol. **1991**;12:165- 170.
54. Engel J Jr. **Mesial temporal lobe epilepsy: what have we learned?** Neuroscientist **2001**;7:340–352
55. Engel J Jr. **Report of the ILAE classification core group**. Epilepsia; 47(9):1558–1568., **2006**
56. Engel J Jr. **Surgery for seizures**. N Engl J Med **1996**;334:647–652.
57. Eriksson, S H, Rugg-Gunn, F J, Symms, M R, Barker, G J and Duncan, J S. **Diffusion tensor imaging in patients with epilepsy and malformations of cortical development**. Brain, **2001**. 124(Pt 3): p. 617-26.
58. Field, A S, Alexander, A L, Wu, Y C, Hasan, K M, Witwer, B and Badie, B. **Diffusion tensor eigenvector directional color imaging patterns in the evaluation of cerebral white matter tracts altered by tumor**. J Magn Reson Imaging, **2004**. 20(4): p. 555-62.
59. Fiorella DJ, Provenzale JM, Coleman RE, Crain BJ, Al-Sugair AA. **(18)F-fluorodeoxyglucose positron emission tomography**

and MR imaging findings in Rasmussen encephalitis. AJNR Am J Neuroradiol **2001**;22:1291–1299.

60. Flugel D, Cercignani M, Symms MR, et al. **Diffusion tensor imaging findings and their correlation with neuropsychological deficits in patients with temporal lobe epilepsy and interictal psychosis**. Epilepsia **2006**; 47:941–944.
61. Freeman JL, Coleman LT, Wellard RM, et al. **MR imaging and spectroscopic study of epileptogenic hypothalamic hamartomas: analysis of 72 cases**. AJNR Am J Neuroradiol **2004**;25:450–462.
62. Garcia PA, Laxer KD, van der Grond J, Hugg JW, et al. **Proton magnetic resonance spectroscopic imaging in patients with frontal lobe epilepsy.** Ann Neurol **1995**; 37:279–281.
63. Gomez-Alonso J, Andrade C, Koukoulis A. **Epileptic seizures and epilepsy: definitions proposed by the International League Against Epilepsy (ILAE) and the International Bureau for Epilepsy (IBE)**.Epilepsia Apr.**2005**
64. Goscinski I, Kunicki A. **On surgical treatment of Sturge-Weber syndrome**. Acta Med Pol **1972**;13:229–236.
65. Gracia P.A. Laxer K.D. of Grond J.V. et al., **Correlation of seizure frequency with N-acetyl aspartate levels determined by 1H magnetic resonance spectroscopic imaging**. Mag. Res. Imaging Vol 15, No. 4: 475 – 478, **1997**.
66. Gray H. **Anatomy of the human body, 20th edition.** *New York: Bartleby.com*, **2000**.
67. Griffiths PD, Blaser S, Boodram MB, Armstrong D, et al. **Choroid plexus size in young children with Sturge-Weber syndrome**. AJNR Am J Neuroradiol **1996**; 17:175–180.
68. Griffiths PD. S**turge-Weber syndrome revisited:the role of neuroradiology**. Neuropediatrics **1996**;27:284–294.
69. Grondin R, Chuang S, Otsubo H, Holowka S, et al. **The role of magnetoencephalography in pediatric epilepsy surgery**. Childs Nerv Syst **2006**; 22:779–785.

70. Gross, D W, Concha, L and Beaulieu, C. **Extratemporal white matter abnormalities in mesial temporal lobe epilepsy demonstrated with diffusion tensor imaging**. Epilepsia, **2006**. 47(8): p. 1360-3.
71. Guermazi A, De Kerviler E, Zagdanski AM, Frija J.**Diagnostic imaging of choroid plexus disease**. Clin Radiol **2000**;55:503–516.
72. Guerreiro MM, Andermann F, Andermann E, et al. **Surgical treatment of epilepsy in tuberous sclerosis:strategies and results in 18 patients**. Neurology **1998**;51:1263–1269.
73. Gupta RK, Saksena S, Agarwal A, Hasan KM, et al. **Diffusion tensor imaging in late posttraumatic epilepsy**. Epilepsia **2005**; 46:1465–1471.
74. Hammen Th. Stefan H, Eberhardt K.E et al., **Clinical applications of 1H-MR spectroscopy in the evaluation of epilepsies**. Acta Neurol Scand. 108: 223 – 238, **2003**.
75. Hammen Th., Stefan H., Pauli E., et al., **1H-MR spectroscopy: A promising method in distinguishing subgroups in temporal lobe epilepsy**, Journal of the neurological sciences, 215: 21-25, **2003**.
76. Hauser W.A. & Banerjee P.N. (**Pediatric Epilepsy,Diagnosis And Therapy Classification, Epidemiology, Etiology, And Diagnosis**) Third Edition, II :162 **,2008**
77. Henry T.R. and Votaw J.R. **The role of positron emission tomography with 18F fluorodeoxy glucose in the evaluation of the epilepsies**. Neuroimag. Clin N. Am. 14: 517-535, **2004**.
78. Ho SS, Kuzniecky RI, Gilliam F, Faught E, et al. **Congenital porencephaly and hippocampal sclerosis. Clinical features and epileptic spectrum**. Neurology **1997**; 49:1382–1388.
79. Ho SS, Kuzniecky RI, Gilliam F, Faught E, et al. **Congenital porencephaly: MR features and relationship to hippocampal sclerosis**. AJNR Am J Neuroradiol **1998**; 19:135–141.

80. Holopainen IE, Lundbom NM, Metsahonkala EL, Komu ME, et al. **Temporal lobe pathology in epilepsy: proton magnetic resonance spectroscopy and positron emission tomography study**. Pediatr Neurol **1997;** 16:98–104.
81. Holopainen IE, Valtonen ME, Komu ME, Sonninen PH, et al. **Proton spectroscopy in children with epilepsy and febrile convulsions**. Pediatr Neurol **1998**; 19:93–99.
82. Hudgins RJ, Flamini JR, Palasis S, Cheng R, Burns TG, Gilreath CL. **Surgical treatment of epilepsy in children caused by focal cortical dysplasia**. Pediatr Neurosurg **2005**;41:70–76.
83. Hunter JV, Wang ZJ. **MR spectroscopy in pediatric neuroradiology.** Magn Reson Imaging Clin N Am**;** 9:165–189, ix. **,2001**
84. ILAE:- **Commission on neuroimaging of the international league against epilepsy. Guidelines for neuroimaging evaluation of patients with uncontrolled epilepsy considered for surgery**. Epilepsia, 38: 1255-6, **1997**.
85. Jack C. **MRI-based hippocampal volume measurements in epilepsy**. Epilepsia**;**35:S21–9. ,**1994**
86. Jack CJ, Gehring DG, Sharbrough FW, et al. **Temporal lobe volume measurement from MR images: accuracy and left–right asymmetry in normal persons.** J Comput Assist Tomogr;12:21–9., **1988**
87. Jack CR Jr, Sharbrough FW, Cascino GD, Hirschorn KA, et al. **Magnetic resonance image-based hippocampal volumetry: correlation with outcome after temporal lobectomy**. Ann Neurol **1992**; 31:138–146.
88. Jack CR Jr, Theodore WH, Cook M, McCarthy G. **MRI-based hippocampal volumetrics: data acquisition, normal ranges, and optimal protocol**. Magn Reson Imaging. **1995**;13:1057-1064.

89. Jack CR, Jr., Sharbrough FW, Twomey CK, et al. **Temporal lobe seizures: lateralization with MR volume measurements of the hippocampal formation**. Radiology **1990**;175:423–429.
90. Jack CR., Rydberg CH., Krecke KN et al., **Mesial temporal sclerosis, diagnosis with FLAIR versus spin- echo MR imaging**. Radiology, 199: 367 – 373, **1996**.
91. James M. Johnston ,Matthew D, Smyth Robert C, McKinstry **Pediatric Epilepsy, Diagnosis and Therapy** Third Edition, Basics of Neuro imaging in Pediatric Epilepsy,213-224**, 2008**
92. Johanson CE, Jones HC. **Promising vistas in hydrocephalus and cerebrospinal fluid research**. Trends Neurosci **2001**;24:631–2.
93. Jozwiak S, Schwartz RA, Janniger CK, Bielicka- Cymerman J. **Usefulness of diagnostic criteria of tuberous sclerosis complex in pediatric patients**. J Child Neurol **2000**;15:652–659.
94. Kahane Ph., Chabardés S., Minotti L. et al., **The role of the temporal pole in the genesis of temporal lobe seizures.** *Epileptic disorders*, 4 supp. (1): S51- S58, **2002**.
95. Kahle W. & Kahle M. F. , **Color Atlas of Human Anatomy,** Vol. 3 : 6-14 , **2003**
96. Kamimura T, Tohyama J, Oishi M, et al. **Magnetoencephalography in patients with tuberous sclerosis and localization-related epilepsy**. Epilepsia **2006**; 47:991–997.
97. Karadag D, Mentzel HJ, Gullmar D, Rating T, et al. **Diffusion tensor imaging in children and adolescents with tuberous sclerosis**. Pediatr Radiol **2005**; 35:980–983.
98. Kerrigan JF, Ng YT, Prenger E, Krishnamoorthy KS, Wang NC, Rekate HL. **Hypothalamic hamartoma and infantile spasms.** Epilepsia **2007**;48:89–95.
99. Kimiwada T, Juhasz C, Makki M, Muzik O, et al. **Hippocampal and thalamic diffusion abnormalities in children with temporal lobe epilepsy**. Epilepsia **2006**; 47:167–175.

100. Knowlton RC, Elgavish R, Howell J, Blount J, et al. **Magnetic source imaging versus intracranial lectroencephalogram in epilepsy surgery: a prospective study**. Ann Neurol **2006**; 9:835–842.
101. Knowlton RC, Laxer KD, Ende G, et al. **Presurgical multimodality neuroimaging in electroencephalographic lateralized temporal lobe epilepsy**. Ann Neurol **1997**;42:829–837.
102. Knowlton RC, Shih J. **Magnetoencephalography in epilepsy.** Epilepsia **2004**; 45 Suppl 4:61–71.
103. Koeller KK, Henry JM. From the archives of the AFIP. **Superficial gliomas: radiologic-pathologic correlation.** RadioGraphics **2001**;21:1533–1556.
104. Komuro H, Yacubova E, Yacubova E, et al. **Mode and tempo of tangential cell migration in the cerebellar external granular layer.** J Neurosci **2001**;21:527–40.
105. Korff CM, Nordli DR Jr. **The clinical-electrographic expression of infantile seizures**. Epilepsy Res; 70 Suppl 1:S116–S31. ,**2006**
106. Koutroumanidis M., Hennessy MJ. Seed PT et al., **Significance of interictal bilateral temporal hypometabolism in temporal lobe epilepsy**. Neurology 54: 1811 – 21, **2000**.
107. Krakow K, Wieshmann UC, Woermann FG, Symms MR, et al. **Multimodal MR imaging: functional, diffusion tensor, and chemical shift imaging in a patient with localization related epilepsy**. Epilepsia **1999**; 40:1459–1462.
108. Kuzniecky R, Hetherington H, Pan J, et al. **Proton spectroscopic imaging at 4.1 tesla in patients with malformations of cortical development and epilepsy.** Neurology **1997**; 48:1018–1024.
109. Kuzniecky R, Jackson G. **Magnetic resonance in epilepsy**. New York, NY: Raven, **1995**.

110. Kuzniecky R. **Clinical applications of MR spectroscopy in epilepsy**. Neuroimag. Clin. N. Am. 14: 507 – 516, **2004**.
111. Kuzniecky R.I. And Knowlton R.C. **Neuroimaging of epilepsy**. Seminars in neurology Vol. 22 no. 3: 279 – 287, **2002**.
112. Kuzniecky RI, Jackson GD. **Temporal lobe epilepsy. In: Magnetic resonance in epilepsy (1st edn)**. New York: Raven Press,:107–82. **,1995**
113. Lawson JA, Nguyen W, Bleasel AF, et al. **ILAE-defined epilepsy syndromes in children: correlation with quantitative MRI.** Epilepsia **1998**; 39:1345–1349.
114. Lee J, Croen LA, Backstrand KH, et al. **Maternal and infant characteristics associated with perinatal arterial stroke in the infant**. JAMA **2005**;293:723–729.
115. Lee JJ, Kang WJ, Lee DS, et al. **Diagnostic performance of 18F-FDG PET and ictal 99mTc-HMPAO SPET in pediatric temporal lobe epilepsy: quantitative analysis by statistical parametric mapping, statistical probabilistic anatomical map, and subtraction ictal SPET**. Seizure **2005**; 14:213–220.
116. Lemieux L., **Electro encephalographic correlated functional MR imaging studies of epileptic activity**. Neuroimaging Clin. N. Am. 14; 487 – 506, **2004**.
117. Li L.M., Caramanos Z., Cendes F. et al., **Lateralization of TLE and Discrimination of TLE from extra TLE using pattern analysis of magnetic resonance spectroscopic and volumetric data.** Epilepsia, 41 (7) 832 - 842, **2000**.
118. Li L.M., Cendes F. Antel S.B., et al., **Prognostic value of proton magnetic resonance spectroscopic imaging for surgical outcome in patients with intractable temporal lobe epilepsy and bilateral hippocampal atrophy.** Ann. Neurol 47: 195 – 200, **2000**.
119. Li L.M., Cendes F., Andermann F., et al., **Spatial extent of neuronal metabolic dysfunction measured by proton MR**

spectroscopic imaging in patient with localization related epilepsy. Epilepsia, 41 (6): 666 – 674, **2000**.

120. Lin JC, Cai L, Cepko CL. **The external granule layer of the developing chick cerebellum generates granule cells and cells of the isthmus and rostral hindbrain.** J Neurosci **2001**;21:159–68.

121. Lin, C P, Tseng, W Y, Cheng, H C and Chen, J H. **Validation of diffusion tensor magnetic resonance axonal fiber imaging with registered manganese-enhanced optic tracts**. Neuroimage, **2001**. 14(5): p. 1035-47.

122. Loddenkemper T, Kellinghaus C, Wyllie E, Najm IM, et al. **A proposal for a five-dimensional patient-oriented epilepsy classification.** Epileptic Disord; 7(4):308–320. ,**2005**

123. Logothetis N.K. **The under pinnings of the BOLD functional magnetic resonance imaging signal**. J neuroscience, 23 (10): 3963 – 71, **2003**.

124. Marı´n O, Anderson SA, Ruberstein JLR. **Origin and molecular specification of striatal interneurons.** J Neurosci **2000**;20:6063– 76.

125. Marin O, Rubenstein JLR. **A long remarkable journey: tangential migration in the telencephalon.** Nature Rev Neurosci **2001**;2:780– 90.

126. Mark L.P., Danielo D.L., Naidich T.P. et al., **The hippocampus**. *AJNR*, 14: 709-712, **1993**.

127. Mathern GW, Babb TL, Vickrey BG, Melendez M, Pretorius JK. **The clinical-pathogenic mechanisms of hippocampal neuron loss and surgical outcomes in temporal lobe epilepsy**. Brain **1995**;118(pt 1):105–118.

128. Maton B.M. and Kuzniecky R.I. **Proton MRS: N acetyl aspartate, Ceratine and Choline**. Adv. Neurol. 83: 253-9, **2000**.

129. Medical gross anatomy atlas images, **section of the hippocampus, anatomy project,** Parthenon Publishing group, **1997**.
130. Meiners L.C, Vander Grand J., Van Rijen P.C. et al., **Proton Magnetic resonance spectroscopy of temporal lobe white matter in patients with histologically proven hippocampal sclerosis**. J Mag. Reson. Imaging 11 (1): 25 – 31, **2000**.
131. Melhem, E R, Mori, S, Mukundan, G, Kraut, M A, Pomper, M G and van Zijl, P C. **Diffusion tensor MR imaging of the brain and white matter tractography**. AJR Am J Roentgenol, **2002**. 178(1): p. 3-16.
132. Mikuni, N, Okada, T, Enatsu, R, Miki, Y, Hanakawa, T, Urayama, S, Kikuta, K, Takahashi, J A, Nozaki, K, Fukuyama, H and Hashimoto, N. **Clinical impact of integrated functional neuronavigation and subcortical electrical stimulation to preserve motor function during resection of brain tumors.** J Neurosurg, **2007**. 106(4): p. 593-8.
133. Minassian BA, Otsubo H, Weiss S, Elliott I, et al. **Magnetoencephalographic localization in pediatric epilepsy surgery: comparison with invasive intracranial electroencephalography**. Ann Neurol **1999**; 46:627–633.
134. Mori, S and van Zijl, P C. **Fiber tracking: principles and strategies - a technical review**. NMR Biomed, **2002**. 15(7-8): p. 468-80.
135. Mori, S and Zhang, J. **Principles of diffusion tensor imaging and its applications to basic neuroscience research**. Neuron, **2006**. 51(5): p. 527-39.
136. Mu¨ ller F, O'Rahilly R. **The human brain at stages 21–23, with particular reference to the cerebral cortical plate and to the development of the cerebellum.** Anat Embryol **1990**;182:375– 400.

137. Mueller S.G. Suhy J, Laxer K.D. et al.**, Reduced extra hippocampal NAA in mesial temporal lobe epilepsy**. Epilepsia, 43 (10): 1210 – 6, **2002**.
138. Mukherjee P, McKinstry RC. **Diffusion tensor imaging and tractography of human braindevelopment**. Neuroimaging Clin N Am **2006**; 16:19–43, vii.
139. Mukonoweshuro W, Wilkinson ID, Griffiths PD. **Proton MR spectroscopy of cortical tubers in adults with tuberous sclerosis complex**. AJNR Am J Neuroradiol **2001**; 22:1920–1925.
140. Mulani SJ, Kothare SV, Patkar DP. **Magnetic resonance volumetric analysis of hippocampi in children in the age group of 6 to 12 years: a pilot study**. Neuroradiology **2005**; 47:552–557.
141. Mullatti N, Selway R, Nashef L, et al. **The clinical spectrum of epilepsy in children and adults with hypothalamic hamartoma.** Epilepsia **2003**; 44:1310–1319.
142. Nguyen, T H, Yoshida, M, Stievenart, J L, Iba-Zizen, M T, Bellinger, L, Abanou, A, Kitahara, K and Cabanis, E A. **MR tractography with diffusion tensor imaging in clinical routine.** Neuroradiology, **2005**. 47(5): p. 334-43.
143. Nimsky, C, Ganslandt, O and Fahlbusch, R. **Implementation of fiber tract navigation**. Neurosurgery, **2006**. 58(4 Suppl 2): p. ONS-292-303; discussion ONS-303-4.
144. Nimsky, C, Ganslandt, O, Hastreiter, P, Wang, R, Benner, T, Sorensen, A G and Fahlbusch, R. **Preoperative and intraoperative diffusion tensor imaging-based fiber tracking in glioma surgery**. Neurosurgery, **2005**. 56(1): p. 130-7; discussion 138.
145. Nimsky, C, Ganslandt, O, Merhof, D, Sorensen, A G and Fahlbusch, R. **Intraoperative visualization of the pyramidal tract by diffusion-tensor-imaging-based fiber tracking**. Neuroimage, **2006**. 30(4): p. 1219-29.

146. Nordli DR Jr, Bazil CW, Scheuer ML, Pedley TA. **Recognition and classification of seizures in infants.** Epilepsia; 38(5):553–560.,**1997**
147. Novotny E, Ashwal S, Shevell M. **Proton magnetic resonance spectroscopy: an emerging technology in pediatric neurology research**. Pediatr Res **1998**; 44:1–10.
148. O'Brien T.J, SO E.L, Mullan B.P, et al., **Subtraction peri-ictal SPECT is predictive of surgical outcome**, Neurology, **2000**.
149. O'Brien TJ, So EL, Meyer FB, Parisi JE, Jack CR. **Progressive hippocampal atrophy in chronic intractable temporal lobe epilepsy**. Ann Neurol. **1999**;45:526-529.
150. Okumura A, Fukatsu H, Kato K, Ikuta T, et al. **Diffusion tensor imaging in frontal lobe epilepsy**. Pediatr Neurol **2004**; 31:203–206.
151. Osborne JP, Fryer A, Webb D. **Epidemiology of tuberous sclerosis**. Ann N Y Acad Sci **1991**; 615:125–127.
152. Otsubo H, Ochi A, Elliott I, et al. **MEG predicts epileptic zone in lesional extrahippocampal epilepsy: 12 pediatric surgery cases**. Epilepsia **2001**; 42:1523–1530.
153. Packard M, Mathew D, Budnik V. **Wnts and TGF beta in synaptogenesis: old friends signalling at new places.** Nat Rev Neurosci **2003**;4:113– 20.
154. Palmini A, Najm I, Avanzini G, et al. **Terminology and classification of the cortical dysplasias**. Neurology **2004**;62(6 suppl 3):S2–S8.
155. Pantano, P., Formisano, R., Ricci, M. et al. **Prolonged muscular laccidity after stroke. Morphological and functional brain alterations**. Brain **1995**; 118 (5): 1329–1338.
156. Park YD, Allison JD, Weiss KL, Smith JR, et al. **Proton magnetic resonance spectroscopic observations of epilepsia partialis continua in children.** J Child Neurol **2000**; 15:729–733.
157. Pasquier B, Peoc HM, Fabre-Bocquentin B, et al. **Surgical pathology of drug-resistant partial epilepsy. A 10-year-**

experience with a series of 327 consecutive resections. Epileptic Disord **2002**; 4:99–119.

158. Powell, H W, Parker, G J, Alexander, D C, Symms, M R, Boulby, P A, Wheeler-Kingshott, C A, Barker, G J, Koepp, M J and Duncan, J S. **MR tractography predicts visual field defects following temporal lobe resection**. Neurology, **2005**. 65(4): p. 596-9.
159. Pressdee D, May L, Eastman E, Grier D. **The use of play therapy in the preparation of children undergoing MR imaging**. Clin Radiol;52:945–7. ,**1997**
160. Rakic P, Sidman RL. **Histogenesis of cortical layers in human cerebellum, particularly the lamina dessicans.** J Comp Neurol **1970**;139:473– 500.
161. Rakic P. **Neuronal migration and contact guidance in the primate telencephalon.** Postgrad Med J **1978**;54: 25–40.
162. Rasmussen T, Andermann F. **Update on the syndrome of "chronic encephalitis" and epilepsy**. Cleve Clin J Med **1989**;56(suppl pt 2):S181–S184.
163. Raybaud C, Guye M, Mancini J, Girard N. **Neuroimaging of epilepsy in children**. Magn Reson Imaging Clin N Am **2001**; 9:121–147, viii.
164. Raybaud C, Shroff M, Rutka JT, Chuang SH. **Imaging surgical epilepsy in children**. Childs Nerv Syst **2006**; 22:786–809.
165. Rickert CH, Paulus W. **Epidemiology of central nervous system tumors in childhood and adolescence based on the new WHO classification**. Childs Nerv Syst **2001**; 17:503–511.
166. Rigamonti D, Drayer BP, Johnson PC, Hadley MN, et al. **The MRI appearance of cavernous malformations (angiomas)**. J Neurosurg **1987**; 67:518–524.
167. Ronald G. Grainger, David Allison . **Pediatric neuroradiology**. Grainger & Allison's Diagnostic Radiology, **2003**.
168. Ross B, Michaelis T: **Clinical applications of magnetic resonance spectroscopy**. Magn Reson Q **1994**.

169. Rugg-Gunn, F J, Eriksson, S H, Symms, M R, Barker, G J and Duncan, J S. **Diffusion tensor imaging of cryptogenic and acquired partial epilepsies**. Brain, **2001**. 124(Pt 3): p. 627-36.
170. Rutten G.J., Ramsey N.F., Van Rijen PC et al., **fMRI-Determined language lateralization in patients with unilateral and mixed language dominance according to the WADA test.** Neuroimaging. 17 (1): 447 – 60, **2002**.
171. Ryvlin Ph., Coste S., Hermier M., and Mauguière F., **Temporal pole MRI abnormalities in temporal lobe epilepsy**. Epileptic disorders, 4 suppl. (1): S 33 – S 39, **2002**.
172. Sachin Rastogi, MD , Christopher Lee, MD , Noriko Salamon, MD **Neuroimaging in Pediatric Epilepsy: A Multimodality Approach.** RadioGraphics **2008**; 28:1079–1095
173. Salmenpera T. M. and Duncan J. S. **Imaging in epilepsy**. J. Neurol. Neurosurg. Psychiatry 76 (suppl. III): iii2-10, **2005**.
174. Salmenpera T., **Damage in the hippocampus, amygdala, Entorrhinal and perirhinal cortex of adults with partial epilepsy,** series of reports No. 55, **2001**.
175. Salmenpera TM, Simister RJ, Bartlett P, Symms MR, et al. **High-resolution diffusion tensor imaging of the hippocampus in temporal lobe epilepsy**. Epilepsy Res **2006**; 71:102–106.
176. Sander JW. **The epidemiology of epilepsy** revisited. Curr Opin Neurol **2003**.
177. Savic I, Lekvall A, Greitz D, Helms G. **MR spectroscopy shows reduced frontal lobe concentrations of N-acetyl aspartate in patients with juvenile myoclonic epilepsy**. Epilepsia **2000**; 41:290–296.
178. Scheiffele P, Fan J, Choih J, Fetter R, et al. **Neuroligin expressed in nonneuronal cells triggers presynaptic development in contacting axons.** Cell **2000**;101: 657– 69.
179. Schmahmann, J D, Pandya, D N, Wang, R, Dai, G, D'Arceuil, H E, de Crespigny, A J and Wedeen, V J. **Association fibre pathways of the brain: parallel observations from diffusion**

spectrum imaging and autoradiography. Brain, **2007**. 130(Pt 3): p. 630-53.
180. Schneider JF, Il'yasov KA, Hennig J, Martin E. **Fast quantitative diffusion-tensor imaging of cerebral white matter from the neonatal period to adolescence**. Neuroradiology **2004**.
181. Schoder H, Erdi YE, Larson SM, Yeund, HWD. **PET/CT: a new imaging technology in nuclear medicine**. Eur J Nucl Med Mol Imaging **2003**.
182. Serafini T. **Finding a partner in a crowd: neuronal diversity and synaptogenesis.** Cell **1999**;98:133– 6.
183. Serles W., Li L.M., Antel S.B. et al., **Time course of postoperative recovery of N-acetyl aspartate in temporal lobe epilepsy**. Epilepsia, 42 (2): 190 -197, **2001**.
184. Sims J. **On the hypertrophy and atrophy of the brain**. R Med Chir Soc **1835**;19:380.
185. Sitoh Y.Y. and Tien R.D. **The limbic system; an overview of the anatomy and its development.** *Neuroimag. Clin. N.Am*. 7: 1-10, **1997**.
186. SO E.L. **Integration of EEG, MRI and SPECT in localizing the seizure focus for epilepsy surgery**. Epilepsia, 41, suppl. 3: S 48 – 54, **2000**.
187. Sperli F, Spinelli L, Seeck M, Kurian M, et al. **EEG source imaging in pediatric epilepsy surgery: a new perspective in presurgical workup**. Epilepsia **2006**; 47:981–990.
188. Suhy J., Laxer K.D. and Capizzano A. A. et al., **1 H MRSI predicts surgical outcome in MRI negative temporal lobe epilepsy**. Neurology, 58 (5): 821 – 3, **2002**.
189. Suzuki WA. **The anatomy, physiology and functions of the perirhinal cortex.** *Curr. opin. Neurobiol*. a: 6: 179 – 186, **1996**.
190. Tassi L, Colombo N, Garbelli R, et al. **Focal cortical dysplasia: neuropathological subtypes, EEG, neuroimaging and surgical outcome**. Brain **2002**;125:1719–1732.

191. Taylor DC, Falconer MA, Bruton CJ, Corsellis JA. **Focal dysplasia of the cerebral cortex in epilepsy**. J Neurol Neurosurg Psychiatry **1971**;34:369–387.
192. Tessier-Lavigne M, Goodman CS. **The molecular biology of axon guidance.** Science **1996**;274:1123– 33.
193. Thivard L, Lehericy S, Krainik A, et al. **Diffusion tensor imaging in medial temporal lobe epilepsy with hippocampal sclerosis.** Neuroimage **2005**; 28:682–690.
194. Thivard, L, Adam, C, Hasboun, D, Clemenceau, S, Dezamis, E, Lehericy, S, Dormont, D, Chiras, J, Baulac, M and Dupont, S. **Interictal diffusion MRI in partial epilepsies explored with intracerebral electrodes**. Brain, **2006**. 129(Pt 2): p. 375-85.
195. Thivard, L, Lehericy, S, Krainik, A, Adam, C, Dormont, D, Chiras, J, Baulac, M and Dupont, S. **Diffusion tensor imaging in medial temporal lobe epilepsy with hippocampal sclerosis.** Neuroimage, **2005**. 28(3): p. 682-90.
196. Ulivelli M., Rocchi R., Valti G. et al., **CAT and MRI in the study of partial epilepsy. Comparison of the two methods and correlation with EEG**. Riv. Neurol., 61 (5): 161– 65, **1991**.
197. Van Essen DC. **A population-average, landmark- and surface-based (PALS) atlas of human cerebral cortex**. Neuroimage **2005**; 28:635–662.
198. Van Paesschen W. and Révész T. **Hippocampal sclerosis.** Neuropathology of epilepsy: 501 – 73, **1997**.
199. Van Paesschen W. **Qualitative and quantitative imaging of the hippocampus in mesial temporal lobe epilepsy with hippocampal sclerosis**. Neuroimaging Clin. N. Am. 4: 373-400, **2004**.
200. Varho T, Komu M, Sonninen P, Lahdetie J, et al. **Quantitative HMRS and MRI volumetry indicate neuronal damage in the hippocampus of children with focal epilepsy and infrequent seizures**. Epilepsia **2005**; 46:696–703.

201. Vermathen P., Ende G., Laxer K.D. et al., **Hippocampal N-acetyl aspartate in neocortical epilepsy and mesial temporal lobe epilepsy**. Ann. Neurol. Aug. 42 (2): 194 – 9, **1997**.
202. Verrotti A, Pizzella V, Trotta D, Madonna L, et al. **Magnetoencephalography in pediatric neurology and in epileptic syndromes**. Pediatr Neurol **2003**; 28:253–261.
203. Vincent Lai,Henry KF Mak, Ada WY Yung,WY Ho,KN Hung Hong Kong Med J Vol 16 No 4 # August **2010** 295
204. Wakana, S, Jiang, H, Nagae-Poetscher, L M, van Zijl, P C and Mori, S. **Fiber tract-based atlas of human white matter anatomy**. Radiology, **2004**. 230(1): p. 77-87.
205. Watson C, Andermann F, Gloor P, et al. **Anatomic basis of amygdaloid and hippocampal volume measurement by magnetic resonance imaging.** Neurology;42:1743–50.,**1992**
206. Wen-Chau W., Chao-Ching H., Hsiao-Wen Ch. et al., **Hippocampal alterations in children with temporal lobe epilepsy with or without a history of febrile convulsions: Evaluations with MR Volumetry and Proton MR Spectroscopy**. Am J Neuroradiol 26:1270–1275, May **2005.**
207. William D.G., **Functional MR imaging of language, memory and sensorimotor cortex**. Neuroimag. Clin. of N. Am., 14: 471 – 485, **2004**.
208. Williamson P., Engel J. and Munari C. **Anatomic classification of localization related epilepsies**. Engel J. editor, Epilepsy: a comprehensive textbook, vol. 3, New York – Lippincott – Raven, P2405-16, **1998**.
209. Woermann FG, McLean MA, Bartlett PA, Barker GJ, et al. **Quantitative short echo time proton magnetic resonance spectroscopic imaging study of malformations of cortical development causing epilepsy.** Brain **2001**; 124:427–436.
210. Wright N B ,**Imaging in epilepsy: a paediatric perspective** , British Journal of Radiology ,74,575-589, **2001**

211. Wu JY, Sutherling WW, Koh S, et al. **Magnetic source imaging localizes epileptogenic zone in children with tuberous sclerosis complex**. Neurology **2006**;66:1270–1272.
212. Wu JY, Sutherling WW, Koh S, Salamon N, et al. **Magnetic source imaging localizes epileptogenic zone in children with tuberous sclerosis complex**. Neurology **2006**; 66:1270–1272.
213. Wu YW, Lynch JK, Nelson KB. **Perinatal arterial stroke: understanding mechanisms and outcomes**. Semin Neurol **2005**;25:424–434.
214. Wyllie E, Chee M, Granstrom ML, et al. **Temporal lobe epilepsy in early childhood**. Epilepsia; 34:859–868. ,**1993**
215. Yagishita A, Arai N, Maehara T, Shimizu H, Tokumaru AM, Oda M. **Focal cortical dysplasia: appearance on MR images.** Radiology **1997**;203:553–559.
216. Yagishita A, Arai N, Tamagawa K, Oda M. **Hemimegalencephaly: signal changes suggesting abnormal myelination on MRI.** Neuroradiology **1998**; 40:734–738.
217. Yogarajah, M and Duncan, J S. **Diffusion-based magnetic resonance imaging and tractography in epilepsy**. Epilepsia, **2007**.
218. Yu, C S, Li, K C, Xuan, Y, Ji, X M and Qin, W. **Diffusion tensor tractography in patients with cerebral tumors: a helpful technique for neurosurgical planning and postoperative assessment**. Eur J Radiol, **2005**. 56(2): p. 197-204.