

Preface

Functional magnetic resonance imaging (fMRI) represents one of the most advanced and enlightening functional imaging techniques that has ever been developed. The past ten years (1990–2000) of scientific research has been designated the decade of the brain and has led to numerous technological developments and the establishment of fundamental clinical protocols to understand brain functions. The next decade, the beginning of the 21st century, will continue the great momentum of brain research. This is currently one of the most exciting and progressive times of scientific advancement in the field of brain function and the development and application of fMRI are the driving forces.

The field of fMRI has two major areas of research interest and applications. The first is within the field of Cognitive Neuroscience, which focuses on understanding all aspects of the mental processes involved in awareness, reasoning, and acquisition of knowledge and behavior. The second is the use of Functional MRI in the Medical Sciences to localize eloquent regions in the brain for a large variety of clinical applications. This book has focused primarily on describing the basic principles of Blood Oxygen Level Dependant (BOLD) imaging and the new and developing clinical applications of fMRI.

This book contains twenty chapters and is separated into three main sections. The first section is an introduction to the physics principles of BOLD imaging as well as a review of fMRI scanning methodologies, data analysis, experimental design, and clinical challenges. The second section is a pictorial Neuroanatomical atlas of the basic motor, sensory, and cognitive activation sites within the brain. This section will give a new clinical scientist a familiarity with some of the more clinically relevant brain activation sites that are discussed in subsequent chapters. The third and final section reviews all the current and future clinical applications of functional MRI. These chapters include the clinical fields of Language, Memory, fMRI WADA, Visual Pathway, Auditory Pathways, Epilepsy, Pain, and Psychiatric Disorders. The cutting edge field of Pharmacological applications of fMRI, including new drug development and drug therapy, is also discussed.

The current clinical fMRI applications include all aspects of pediatric and adult brain imaging. There has never previously been a non-invasive technique with high spatial and temporal resolution to define brain activation. One of the current primary indications for clinical fMRI is evaluation of eloquent areas of the brain such as the cortical spinal tract in relation to a focal parenchymal brain lesion (for example, a neoplasm or arterial venous malformation). Additionally, use of fMRI to localize language centers in the frontal lobe and temporal lobes is becoming a commonplace procedure for presurgical evaluation in temporal lobe epilepsy and regional masses. The concept of a fMRI WADA test is reviewed in detail. Please note that most of the fMRI images are presented in radiologic coordinates (the left side of the image represents the right side of the subject). Images presented in neurologic coordinates (the left side of the image represents the left side of the subject) will be indicated.

The field of fMRI is in its infancy and although the field is relatively young, there has been a discovery of a tremendous body of knowledge. Functional MRI has grown to be a vital tool for clinical and cognitive neuroscience research. It is our hope that this book will give a thorough introduction to this exciting new field and will be a reference, to all physicians and cognitive neuroscientists, for the emerging clinical applications of fMRI.

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