Why do we need a book on the dating of neurological injury? Over the last decade, I have personally reviewed more than 80 medical–legal cases related to neurological disease in which some aspect of the case involved imaging technology. Many cases – in clinical situations, such as alleged birth-related hypoxia or ischemia, surgically-related injuries, or trauma-induced spinal cord or brain substance abnormalities, for example – shared the need both to detect the presence of an injury and to date the time it occurred. While a minority of cases involved the misdiagnosis of an aneurysm, a delayed diagnosis of spinal fracture, or orbital injury during a surgical procedure, the large majority of cases used modern imaging, first to detect if an injury had occurred to the brain substance or the spinal cord (collectively referred to as the central nervous system) and second to determine, if an injury did occur, at what time it occurred.

In a medical–legal setting, the interplay between the radiographic findings and the clinical findings has several possible scenarios. On one extreme, the imaging findings may be so unequivocal that no doubt exists as to what occurred and even little doubt about when it occurred. On the opposite extreme, the radiologic findings may be either completely noncontributory or may show that an event occurred but offer no insight into when it occurred (and hence its proximate cause). In between is a gray area in which the clinical history can often be very helpful in delineating the imaging findings to more accuracy and specificity; and the reverse may also be true, i.e., that the radiology may help clarify the clinical picture. My hope is that this text will be helpful in all situations – from those in which radiology is clear, to those in which the findings are less certain though still present – by providing guidelines and principles for the application of imaging findings.

The realm of this book is not to discuss specific clinical and radiographic findings at the level of the medical expert radiologist, nor is it intended to be an exhaustive treatise on recognizing the imaging signs of brain abnormality, as that is more appropriately covered in a textbook on medical imaging. Rather, I intend to represent in a systematic fashion the principles involved in the interpretation of images of the central nervous system specifically in a medical–legal setting where concern exists about the occurrence and timing of an injury.

What this book uniquely presents is a new way to approach the dating of neurological injury as imaged by modern computed tomography (CT), magnetic resonance (MR), and ultrasound (US). Throughout the text, I describe dating by two distinct but complementary methods. In the first, I explain how knowledge of the dynamic and rapidly changing imaging findings that occur in the first few weeks after an injury permit dating in this acute period. In the second, I illustrate how patterns of injury with specific features can date with some accuracy the time an injury occurs, which may be much earlier than the time when the image was obtained. This tends to be dating that occurs in the chronic period.

Chapters are presented in a logical progression beginning with the general appearance of normal brain and progressing to the way abnormalities manifest themselves on CT, MR, and US images. The emphasis in these discussions is on the appearance of edema and of hemorrhage, as these two findings are the brain’s most common response to injury. I discuss the role of contrast in central
nervous system (CNS) imaging, which will lead to a discussion of how infarction (death of tissue), ischemia (decreased blood flow to tissue that is still potentially alive and recoverable), and hemorrhage change with time as seen on CT, MR, and US images, and a dialog of what different patterns of injury tells us about the mechanism, severity, and duration of injury. This then permits a statement of what I consider the overriding principles of image interpretation as they relate to legal matters and a frank discussion, based on everything mentioned up to this point, of what can and what cannot be said in a medical–legal setting based on the imaging findings. The last chapter is on the root causes for uncertainty in dating neurologic events from imaging studies.
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