Objectives: To learn about the key anatomical features and their functional relevance, reflected by the MRI of the brain during selected stages of the prenatal and postnatal development as well as aging.

Overview: Brain structure undergoes major changes throughout development, adulthood, and aging. Over the past decade, MRI has become an indispensable tool for gaining insights into the human brain structure and function. Development of the new MR modalities, such as diffusion tensor imaging, as well as the availability of higher magnetic strengths improving the resolution of the acquired signals, has substantially increased our ability to visualize the brain tissue in detail. Fetal brain imaging is now possible, providing us with an unprecedented tool to follow normal development as well as to diagnose abnormalities as they form. Detailed quantitative analysis of the specific brain regions can now be used to determine the risk of developing Alzheimer’s disease. Multimodal imaging, while still in its infancy, has been envisioned as the ultimate tool for discoveries of diagnostic, prognostic, and therapeutic biomarkers, particularly as we move to the personalized medicine era. To understand the pathology of brain disorders which occur throughout life, it is essential to learn about the underlying brain anatomy. The anatomy, on the other hand, is best understood when connected to function. Once the structure/function is understood, the clinical aspect of any disease will fall into place.

Methods: The overview of the brain anatomy during development and aging will be discussed by correlating the histological/anatomical brain sections with their MRI representations. Three aspects will be utilized – a global view (macroscopic anatomy), a regional focus (microscopic anatomy) and the functional aspect (clinical anatomy). Globally, major dependable landmarks which demarcate the regions of the brain at each developmental milestone will be outlined. Focus on the specific regions will include their formation in utero as well as postnatally. Association of these specific regions with their specific functional activities will be discussed. Examples of the pathology will be given, with a brief discussion how their effects on anatomy and the function are reflected by clinical symptomatology. Structural, volumetric, and diffusion tensor imaging will be correlated to facilitate the global understanding of brain function as well as pathology.

Suggested readings: