Interstitial Diffusivity (D_{int})

Definition: `'Interstitial Diffusivity'` (`'$D_{int}$'`) refers to the rate at which water molecules diffuse within the brain's **interstitial (extracellular)** space. It reflects the mobility of fluid in the parenchymal extracellular environment, distinct from intracellular or vascular compartments.

Physiological Basis:

- In healthy brain tissue, D_{int} is influenced by:
  1. **Extracellular matrix composition**
  2. **Interstitial space geometry**
  3. **Viscosity and flow resistance**
- Interstitial water contributes to metabolic waste clearance, nutrient transport, and glymphatic circulation.

Measurement Techniques:

- Estimated using advanced diffusion MRI, especially:
  1. Spectral diffusion analysis
  2. Multi-compartment diffusion models
- Requires high angular and multi-b-value data to isolate the extracellular component of water diffusion.

Clinical Relevance:

- ↓ D_{int} → Suggests stagnation or restricted ISF flow

(e.g., in idiopathic normal pressure hydrocephalus or glymphatic failure)

- ↑ D_{int} → May reflect increased ISF mobility or reduced structural barriers

(e.g., extracellular matrix degradation in aging or neurodegeneration)

Diagnostic Potential:

- May serve as a **non-invasive biomarker** of:
  1. Interstitial flow efficiency
  2. Parenchymal compliance
  3. Glymphatic system status
- Used in conjunction with F_{int} — Interstitial Fluid Volume Fraction for characterization of brain fluid dynamics.

In iNPH:

- D_{int} is often **reduced**, especially in periventricular white matter.
- This may reflect impaired glymphatic flow and contribute to ventricular enlargement and white matter damage.

Related Concepts:

- Diffusivity (D)
- Interstitial fluid dynamics
- Spectral diffusion analysis
- F_{int} — Interstitial Fluid Volume Fraction
- Glymphatic system