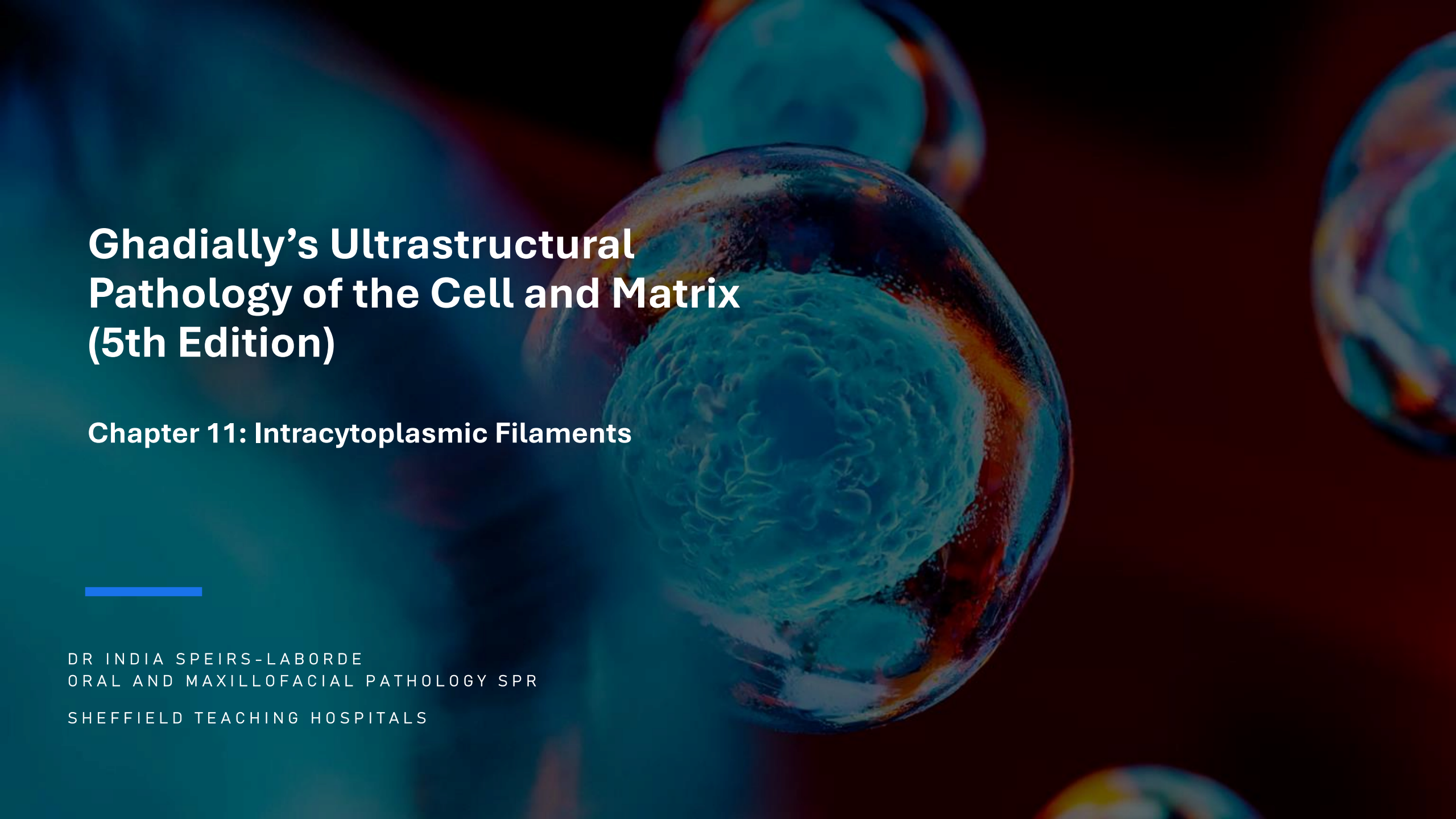




Ghadially's Ultrastructural Pathology of the Cell and Matrix (5th Edition)

Chapter 11: Intracytoplasmic Filaments

DR INDIA SPEIRS-LABORDE
ORAL AND MAXILLOFACIAL PATHOLOGY SPR
SHEFFIELD TEACHING HOSPITALS



Introduction

- What Are Intracytoplasmic Filaments?
- Protein-based scaffolding structures within the cytoplasm
- Maintain cell shape, mechanical integrity, and internal organization
- Respond dynamically to stress, signaling, and pathological conditions

Three Families of Filaments

- 1. Microfilaments (Actin)
 - Dynamic, involved in motility and endocytosis
- 2. Intermediate Filaments
 - Tissue-specific, mechanical stability
- 3. Microtubules
 - Intracellular transport, mitosis, and polarity
- Question:
Which filament type would break first under mechanical stress?
- (A) Microfilaments • (B) Microtubules • (C) Intermediate Filaments
- 👉 Answer: Microfilaments – most dynamic and delicate



Microfilaments – Overview

- Structure & Composition
- Smallest cytoskeletal filaments (~7 nm diameter)
- Composed of **actin**: G-actin (globular) polymerizes into F-actin (filamentous)
- Polarized: **barbed (+) end** grows faster than **pointed (–) end**
- Highly concentrated beneath the plasma membrane (cell cortex)
- Functions include: **cell motility, facilitating vesicle movement, muscle contraction, and cytokinesis**

Microtubules – Overview

- Structure & Composition
- Largest cytoskeletal filaments (~25 nm diameter)
- Hollow tubes of α - and β -tubulin dimers
- 13 protofilaments form a cylindrical lattice
- Polarized: **plus (+) end** grows faster than **minus (–) end**
- Originate from **microtubule-organizing centers (MTOCs)** like the centrosome
- Functions include: intracellular transport, chromosome separation, cell polarity and organelle positioning

- *Where are microfilaments most concentrated in a cell?*

- A) Nucleus • B) Golgi • C) Cell cortex • D) Mitochondria

- 👉 *Answer: C) Cell cortex*

- *What protein forms the building blocks of microtubules?*

- A) Actin • B) Tubulin • C) Keratin • D) Myosin

- 👉 *Answer: B) Tubulin*

- *Which of these is NOT a function of microfilaments?*

- A) Muscle contraction • B) Chromosome separation • C) Cell motility • D) Cytokinesis

- 👉 *Answer: B) Chromosome separation (that's microtubules)*



Intermediate Filaments – Overview

- 10 nm diameter – between actin and microtubules
- ~70 genes, tissue-specific expression
- Function as flexible, load-bearing cables
- Organize organelles, reinforce junctions, resist strain



Types I & II – Keratins (Epithelial)

- Acidic (Type I) + basic (Type II) keratins form heterodimers
- Expressed in stratified and simple epithelia
- Provide barrier resilience in skin, hair, nails
- Mutations → blistering disorders (e.g., **epidermolysis bullosa**)



Type III – Vimentin Family (Connective & Neural Tissues)

- Vimentin: in fibroblasts, endothelium; organelle positioning
- Desmin: stabilizes contractile apparatus in muscle
- GFAP: critical for astrocyte structure and blood-brain barrier
- Peripherin: supports peripheral neuronal architecture



Type IV – Neurofilaments (Neurons)

- Composed of NF-L, NF-M, and NF-H
- Determine axon diameter and conduction velocity
- Accumulations found in ALS, Alzheimer's, Parkinson's
- Can serve as CSF biomarkers for early diagnosis

Type V – Lamins (Nuclear Envelope)

- Structural meshwork lining the nuclear lamina
- Lamins A/C and B involved in chromatin regulation and mitosis
- Defects → Laminopathies (e.g., **progeria**, muscular dystrophies)



Type VI – Beaded Filaments (Lens Cells)

- Specific to lens fiber cells
- Composed of filensin and phakinin
- Provide clarity, resilience, and alignment of lens structure
- Disruption linked to cataract formation

-
- *Where are lamins found?*

(A) Cytoplasm · (B) Nucleus · (C) Golgi · (D) ER

- 🙌 *Answer: B) Nucleus*

- **Question:**

True or false: IFs are mainly responsible for intracellular transport.

- 🙌 *False – that's primarily microtubules.*

Thank You!

Questions? Read Chapter 11!