Carpal Kinematics

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Why Bother?

- Patterns of Movement
- Patterns of injury
- Goals of repair
Objectives

- Summarize 4 theories
- Describe anatomical and functional relations
- Describe biomechanical and kinematic relationships
Four Theories

- Row Theory – Johnston, 1907
- Column Theory – Navarro, 1909
- Modified Column – Taleisnik, 1978
- Oval Ring – Lichtman, 1981
Row Theory

- Cadaver study
- 2 Rigid rows that slide on each other
- Too simplistic
- Dual joint idea persisted

Johnston, 1907
Column Theory

- Flex/Ext column
- Mobile column
- Rotational column

Navarro, 1909
Column Theory

- Theory accounts for radial and ulnar deviation and flexion extension

- Describes contact surface control system (term later coined by Weber)

- Points 2 plane excursion of the Triquetrum
Modified Column Theory

- Flex/Ext column
- Mobile column
- Rotational column

Taleisnik, 1978
Modified Column Theory

- Credits previous work of Navarro and McConailll

- Details ligamentous structure and correlates relevance to in vivo mechanics
Classification of Wrist Ligaments

Extrinsic

Proximal (Radiocarpal)
- Radial Collateral
- Volar Collateral

Ulnocarpal Complex
- Superficial
  - Radioscaphocapitate
  - Radiolunate
  - Radioscapholunate
- Deep
  - Radiotriquetral
  - TFCC
  - Ulnolunate
  - Ulnar Collateral

Dorsal Radiocarpal

Distal (Carpo-metacarpal)
- Volar
  - Dorsal Intercarpal
- Dorsal
  - Radial Collateral
  - Volar Collateral

Intrinsic

Short
- Interosseous

Intermediate
- Lunate-Triquetral
- Scaphoid-Lunate
- Scaphoid-Trapezium

Long
- Volar Intercarpal
- Dorsal Intercarpal

Taleisnik J. Hand Surg, 1976
Classification of Wrist Ligaments

Conceptually:

- **Intrinsic** – Bind Carpals, longer intrinsics allow greater ROM eg. Scapholunate

- **Extrinsic** –
  - Fix Carpals to radius and ulna and control wrist ROM
  - Constrain carpal excursion when taught eg. Radioscaphocapitate in dorsiflexion
Oval Ring

- Proximal and distal row relatively fixed but connected by 2 mobile segments

- Highlighted the importance of the triquetrohamate articulation

Lichtman, 1981
Oval Ring

- Helicoid facet creates plane excursions of triquetrum
- Provides stability in ulnar deviation and volar flexion
- Explains how damage to either scapholunate or triquetrolunate causes midcarpal instability

Lichtman, 1981
Which one wins?
(Take Home Points)

- All contribute some understanding to a complex articulation

Key Concepts:
- Dual articular system (summative ROM)
- Contact surface control system
- Scapholunate, triquetro-lunate most mobile and most vulnerable to damage
Which one wins?
(Take Home Points)

- Path of least resistance injury patterns
- Post injury biomechanics
References


Additional

