No. 15

Biomechanics of Rotator Cuff Tears

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I. Anatomy and Function

◉ Rotator cuff muscles = Circumpennate muscles[16]
◉ Pennation angle
◉ SSP ➜ superior facet, ISP ➜ middle facet, TM ➜ inferior facet
◉ Mover
 - Kinematic moment arms[11]
 - Contribution to shoulder abduction: Deltoid 77%, SSP 10%, ISP 3%, SSC 13%[4,11,22]
◉ Stabilizer
 - Concavity-compression effect[3,14]
 - Stability ratio[13]
 - Dynamic stability index[12]
 - Dynamic stability provided by the cuff muscles[9]

II. Mechanical environment as pathogenesis of rotator cuff tears

◉ Acromion
 - Acromial shape as an extrinsic factor[2,18]
◉ Mechanical properties of the cuff tendon
 - SSP: Ultimate load = 410 N, strength = 16.5 MPa, Elastic modulus = 160 MPa[7]
 - ISP: Ultimate load = 677 N[5]
 - SSC: Ultimate load = 623 N[6]
◉ Stress concentration in the tendon
 - Mechanical environment: stress concentration on the articular surface of SSP tendon attachment site[19,23]
◉ Tear expansion

- Remnant tendon tissue sustains stress concentration in a shoulder model with partial-thickness tears[17]
- Stress concentration on the anterior and posterior edges of the tear
- Zipper phenomenon

III. Pathophysiology

◉ Morphological changes
- muscle atrophy[20]
- fat infiltration[15]
- LHB tendon thickening[1]

◉ Functional changes
- muscle weakness[8]
- dynamic instability[21]
- loss of muscle elasticity[10]

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