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Knee, Elbow & Shoulder Surgery

Rotator Cuff Repairs

- » Failure rate 5 - 20%
- » up to 50% in massive retracted tears
- » Late failures
- » Factors -time to surgery, fatty atrophy, compliance, tendon quality/ retraction, smoking, fixation, technique
- » Failure to reconstitute the enthesis

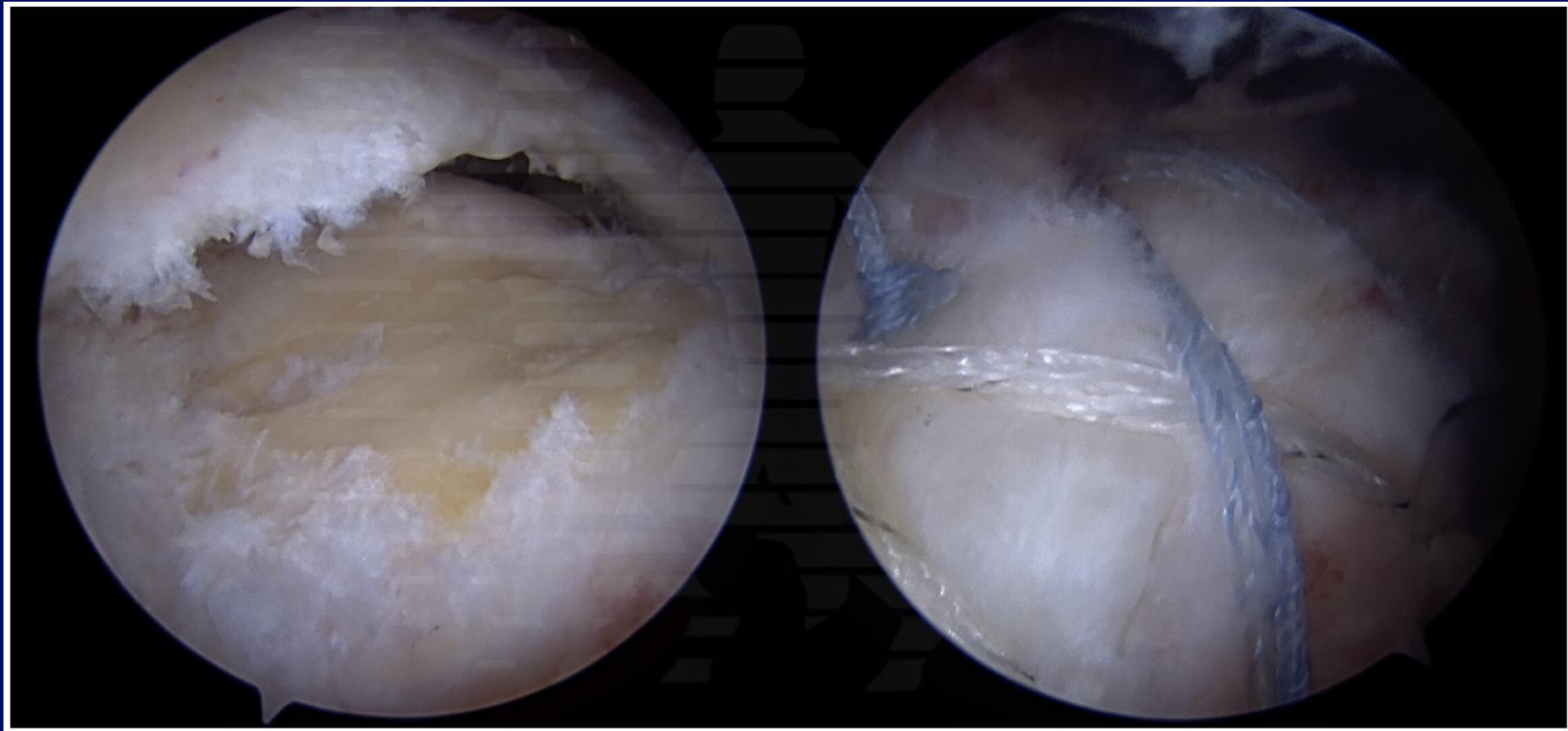


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Augmentation of the Entthesis in Rotator Cuff Repair



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Rotator Cuff Tears

- » Failure at the Enthesis
- » Tendon Avulsed from Bone
- » Goal of Repair is to re-establish the enthesis, restore force couples



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Enthesis

- » Integration of tendon or ligament into Bone
- » Transmits force from muscle contraction
- » dissipating force away from the enthesis
- » Highly Specialised structure
- » 2 main types -Fibrous, Fibrocartilaginous



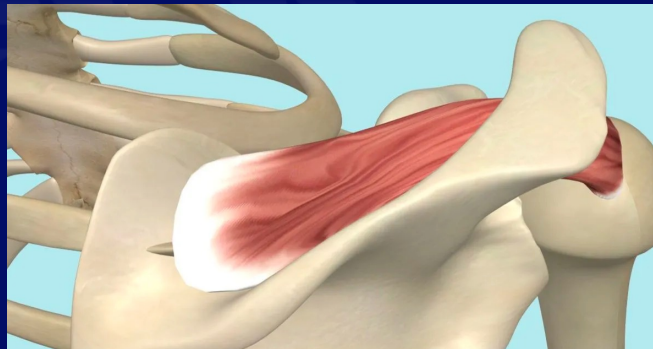
Fibrous

- » Metaphysis and Diaphysis of long bones
- » perforating collagen fibres
- » minimal change in angle of insertion during movement



Fibrocartilaginous

- » Epiphysis and Apophysis
- » large change in angle of insertion with movement - increase in mechanical stress
- » 4 distinct zones - progressive transition from soft tissue to bone acts as damper for force transmission



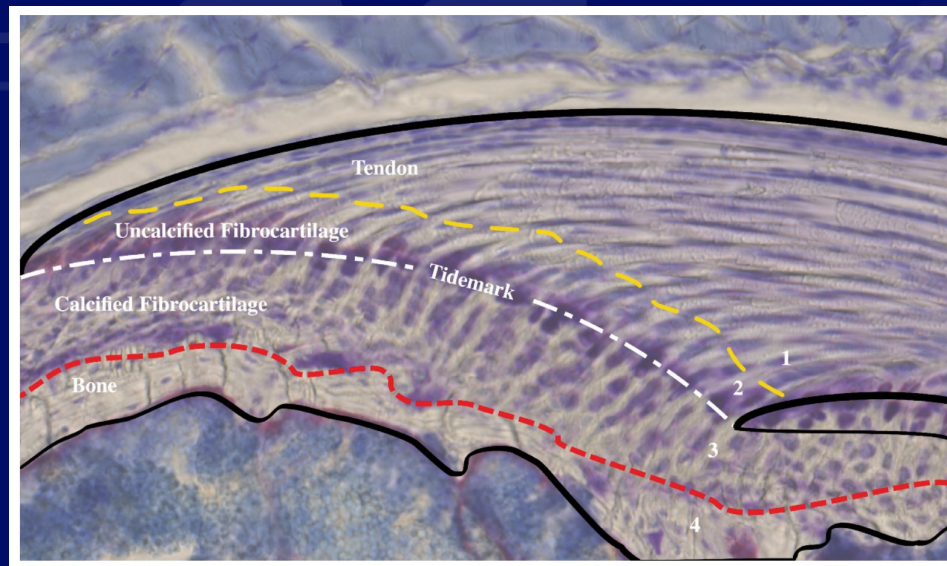
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1 Fibrous Connective Tissue

- » Tendon
- » fibroblasts
- » linear type 1 collagen
- » Type 3 collagen, elastin, proteoglycans



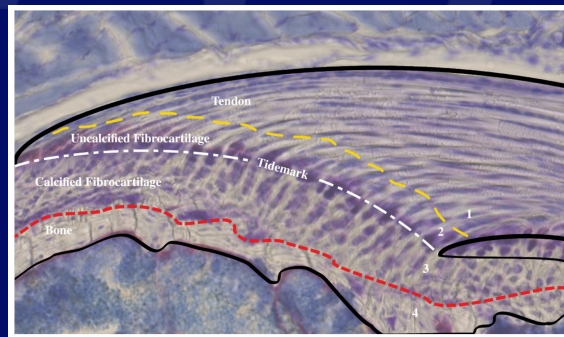
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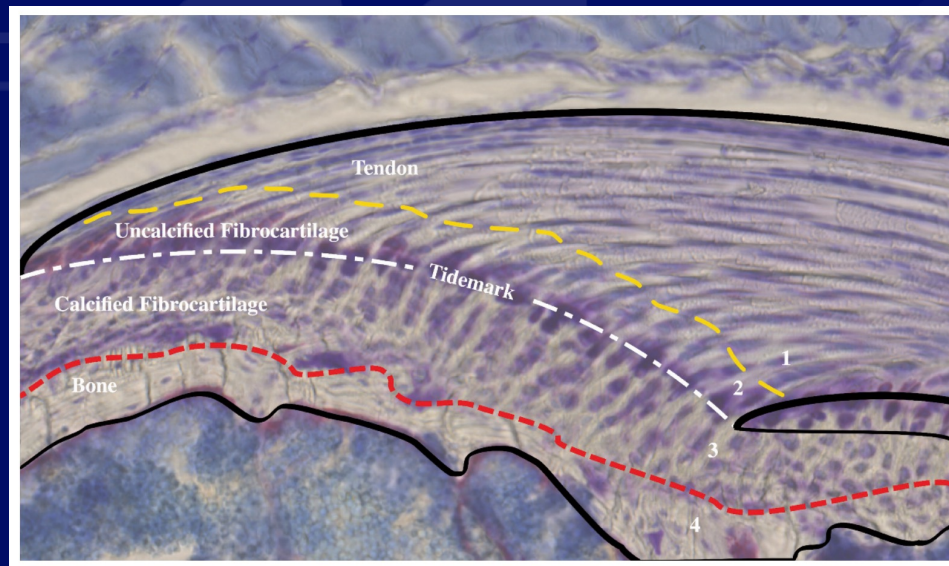
2 Uncalcified Fibrocartilage

- » Uncalcified fibrocartilage
- » avascular
- » Fibrocytes
- » proteoglycan aggregates
- » Type 1, 2, 3 collagen
- » force damping for changing angle of insertion



Tidemark

- » Basophilic Line
- » Separates uncalcified and calcified zones
- » Straight / flat avoiding stress risers at interface



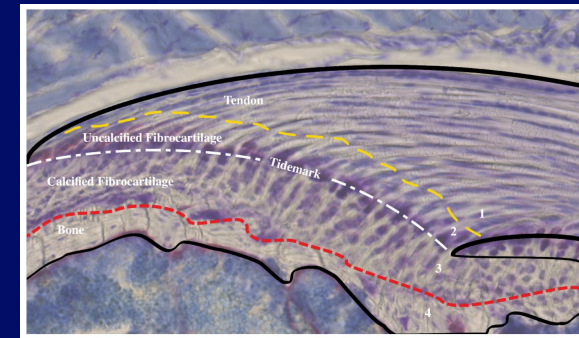
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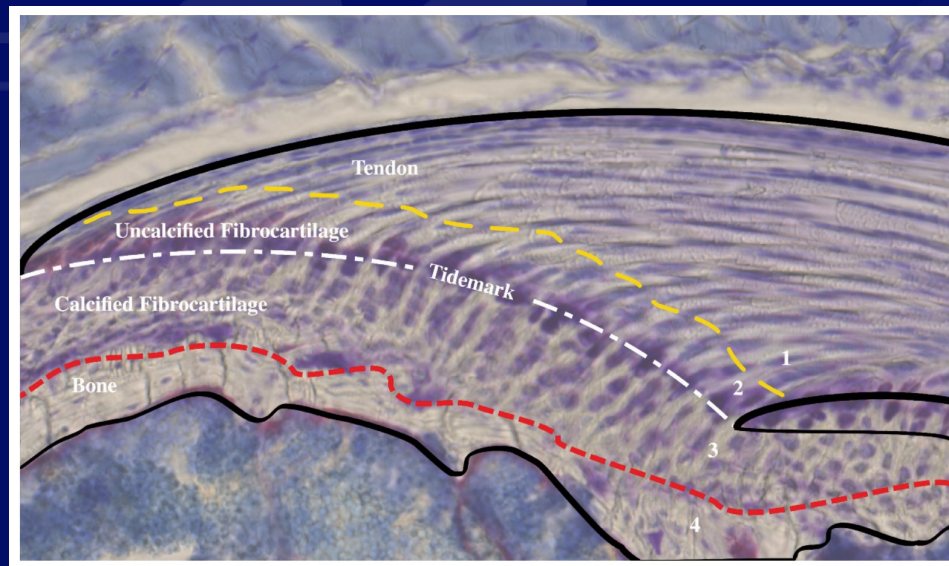
3 Calcified Cartilage

- » Avascular zone of calcified fibrocartilage
- » Fibrochondrocytes
- » Type 2 collagen
- » Aggrecan, type 1, 2 collagen
- » irregular interlocking with the bone layer for mechanical integrity and force transmission
- » Barrier to cells and blood vessels



4 Bone

- » Osteoclasts osteoblasts, osteocytes
- » Type 1 collagen
- » Hydroxy apatite



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Healing in Rotator Cuff Repair

- » Doesn't recreate the Enthesis
- » Fibrovascular Scar tissue- mechanically inferior in both initial strength and durability
- » 3 Stages - Inflammatory
 - » - Repair
 - » - remodelling



Inflammatory

- » 0 - 7 Days
- » Platelets - fibrin fibrinonectin, IGF, PDGF, TGF-B
- » Attraction Macrophages -TGF-B1



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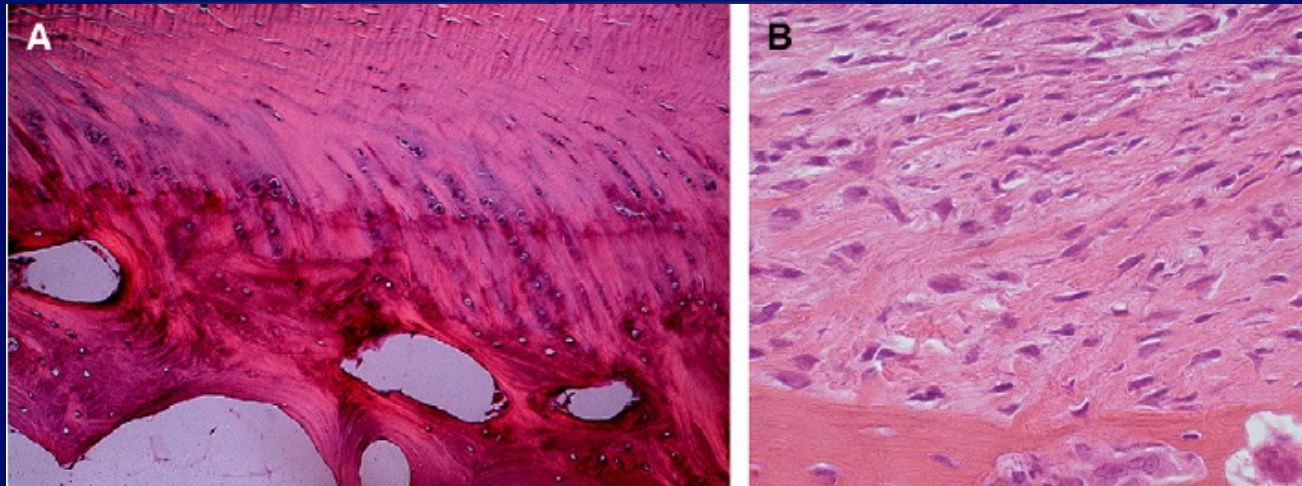
Repair / Remodeling Phase

- » Macrophages secretes TGF-B1
- » Fibroblast proliferation
- » Scar tissue - Type 3 Collegen
- » 5-14 days
- » Remodelled by Matrix Metalloproteinases
- » > 14 days



Healing in rotator cuff repair

» Enthesis Post Repair



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Development of the Entthesis

- » The entheses form during embryological development as a result of a complex interaction of both biological and mechanical forces including the staged effect of multiple growth factors
- » Difficult to replicate



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Enthesis Reconstruction

- » Multipotential Stem Cells
- » Growth Factors
- » Scapholds



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Platelet Rich Plasma

- » Platelet Derived Growth Factor B -chemotaxis, cell proliferation, ECM proliferation, integrin exp., revasculariasation
- » increases collagen synthesis and organisation
- » FGF, TGF-B, IGF 1&2, VEGF
- » Animal studies restoration of some features of enthesis
- » Some evidence for decreased failure rate in massive Rotator cuff tears



PRP

- » Delivery
- » Acute phase reactants
- » Probably results in a more robust predictable Fibrovascular scar rather than reconstitution of Enthesis



Demineralised Bone Fibre

» Collegen 1, Bone sailoprotien, osteopoitin IGF-1, FGF, VEGF, PDGF

Bone Morphogenetic Proteins – Famille TGF- β (n>20)		
BMP-2	BMP-2a	Bone and cartilage morphogenesis , osteoinduction, osteoblast differentiation, apoptosis
BMP-3	Osteogenin	Negative regulator of bone morphogenesis
BMP-3b	GDF-10	Negative regulator of bone morphogenesis
BMP-4	BMP-2b	Teeth, cartilage and bone morphogenesis
BMP-5	-	Limb development, cartilage and bone morphogenesis
BMP-6	Vgr-1, DVR-6	Osteoblast differentiation, chondrogenesis
BMP-7	OP-1	Cartilage and bone morphogenesis
BMP-8	OP-2	Bone and cartilage morphogenesis
BMP-9	GDF-2	Bone morphogenesis
BMP-11	GDF-11	Axial skeleton patterning
BMP-12	CDMP-3, GDF-7	Ligament and tendon development
BMP-13	CDMP-2, GDF-6	Cartilage development and hypertrophy
BMP-14	CDMP-1, GDF-5	Chondrogenesis, angiogenesis



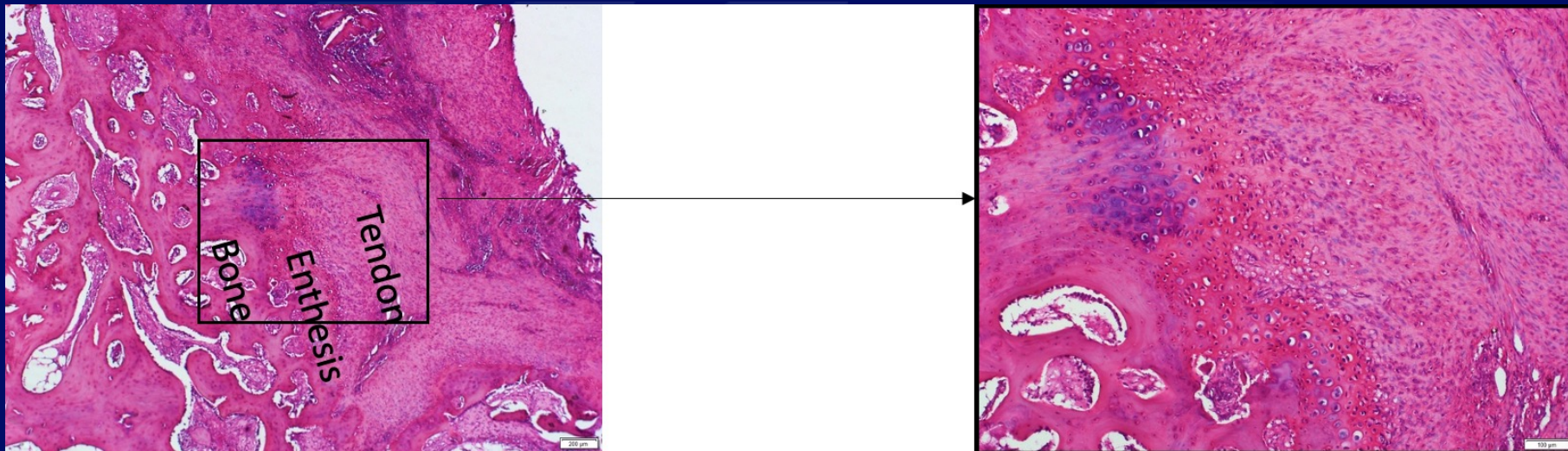
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Demineralised bone Fibre

- » Osteoconductive, osteoinductive
- » Enhanced tendon healing and synthesis
- » restoration of enthesis in several animal studies



Demineralised Bone Fibre

- » Delivery
- » Durability in aqueous environments
- » destruction of nano architecture with demineralisation



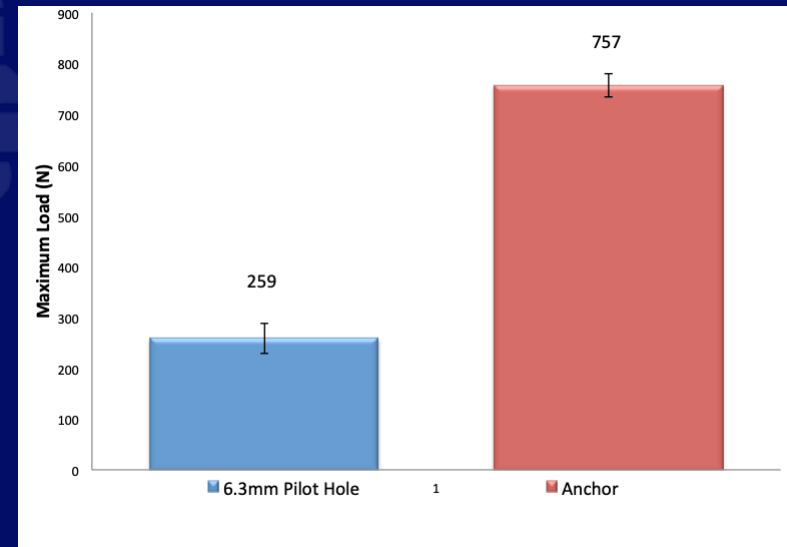
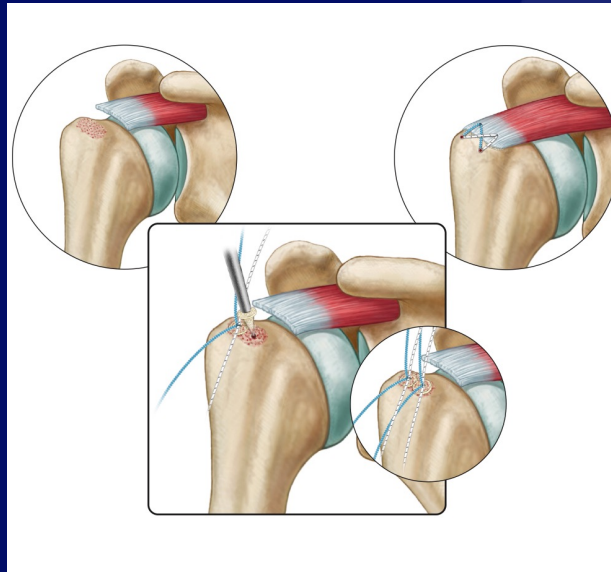
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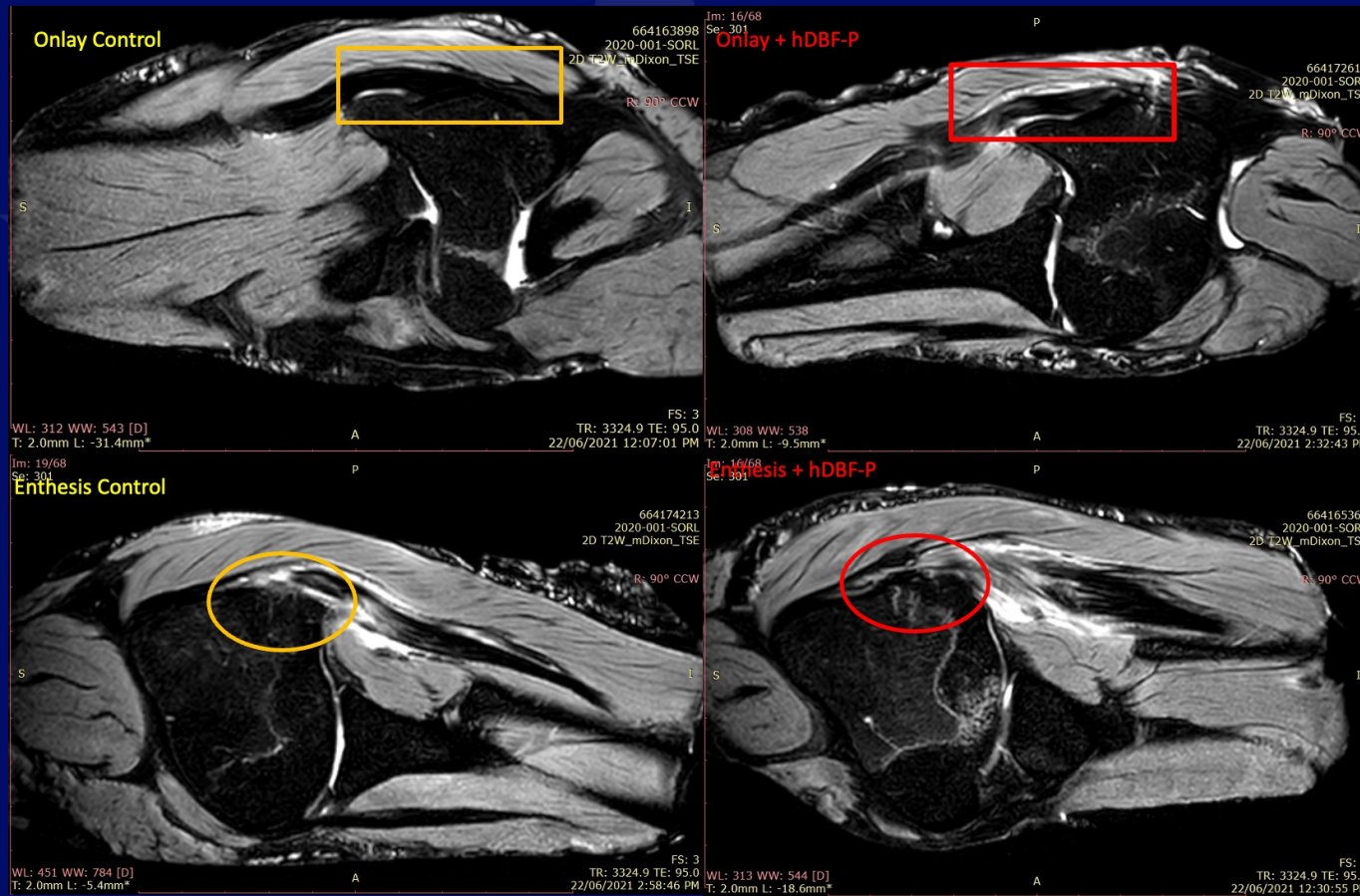
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Enfix

- » Stable in aqueous environments
- » maintain nano architecture
- » insert prior to medial row anchors enhancing fixation



Restoration of Entthesis

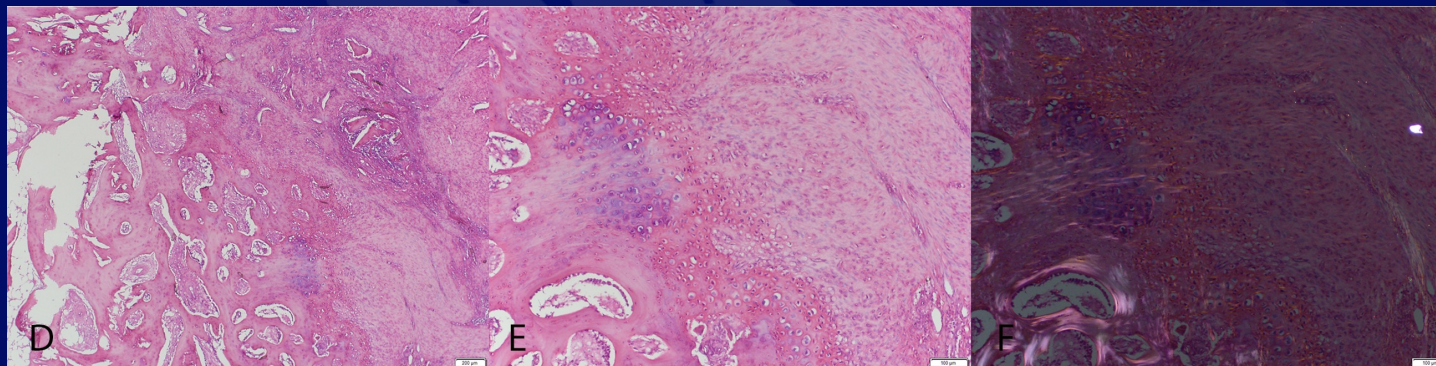
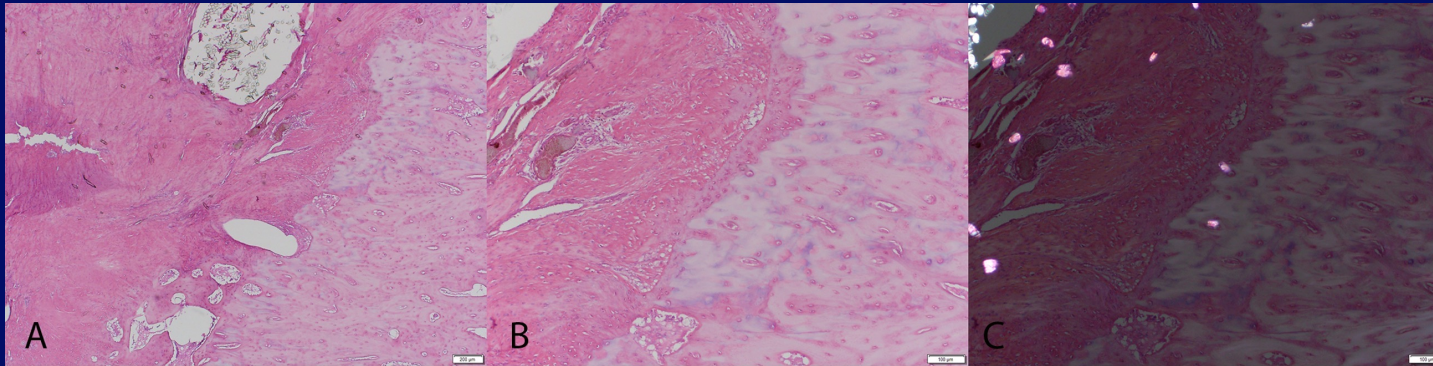


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Restoration of Entesis



Thank You



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