

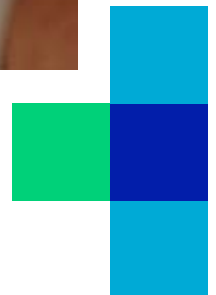
Key note medicine Finger injuries in rock climbing

V. Schöffl



LOWA

simply more...





Epidemiology of sport climbing injuries

Definitions: 5 major types of climbing

- mountaineering
- traditional (alpine) rock climbing
- sport climbing (incl. bouldering)
- indoor climbing (including competition climbing)
- vertical ice climbing (including frozen waterfalls)

All have different risks in accordance to objective danger, environmental hazards, safety margins etc.



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Climbers are an inhomogenous group: No age limitation



Fred Beckey 88y,
2013 90th birthday

One Move too Many



Luc and Keo 1y9m



Gender

- Alpine, sport and indoor climbing: inhomogeneous gender distribution (Schöffl, Neuhof, Jones, Josephsen, Backe, Bowie, Schussmann and more)
- Ice climbing: female climbers were injured more often (76.9%) than males (58.7%) (Schwarz, Schöffl)
- Mountaineering: Inhomogeneous distribution (McIntosh, Schussmann, Stephens). In fatal accidents significantly more men are involved than women (Küpper).



Anatomical location

- Sport and Indoor climbing: Mostly upper extremity, mostly overstrain injury
- Alpine Climbing: Mostly lower extremity due to fall
- Ice Climbing: Head and the upper extremity
- Mountaineering: 36% head or vertebral column, 14.3% trunk, 25.5% legs, and 14.1% arms

(Küpper et al.)

(see review: Schöffl et al. 2012)



Injury Type

- Alpine, sport and indoor climbing: fractures, strains and sprains are predominant, hand and finger injuries are the most common (see review: Schöffl et al. 2012).
- Ice Climbing: Mostly open wounds and haematoma (Schwarz, Schöffl)
- Mountaineering: associated with higher graded trauma, multiple fractures, severe wounds and polytraumatic patients (Küpper)



too Many



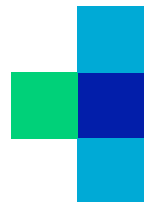
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Sportclimbing: Injury distribution according to body area (2009-2012: n=911, and 1998-2001: n=604)

	2009	-	2012	1998	-	2001
Body area	n		%	n		%
Finger	474		52	247		41
Shoulder	157		17.2	30		5
Hand	119		13.1	47		7.8
Forearm and elbow	83		9.1	81		13.4
Lower leg/foot	35		3.8	55		9.1
Knee	19		2.1	22		3.6
Trunk and spine	17		1.9	43		7.1
Pelvis	4		0.4	0		0
Other	3		0.3	79		13

(Schöffl, Hochholzer, Winkelmann, Strecker, Dt.Z.f.Sportmed.2/2003 and Schöffl et al. 2014 in press)

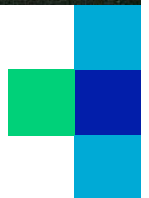
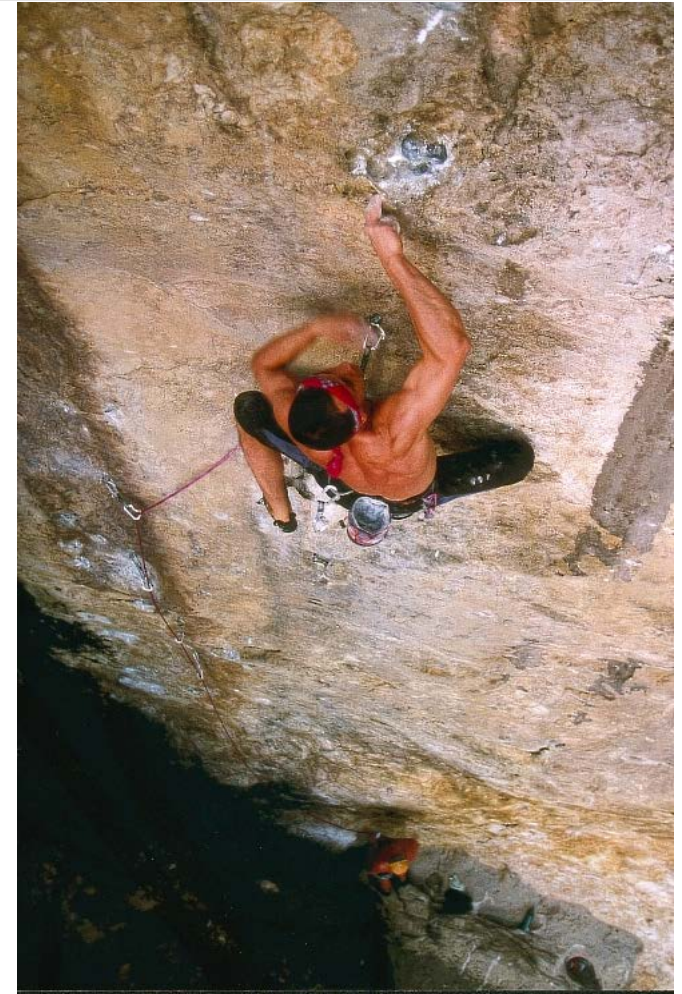
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10 most frequent injuries (2009-2012: n=911, and 1998-2001: n=604)

2009-2012			1998-2001		
Injury	n	%*	Injury	n	%*
Pulley injury	140	15.4	Pulley Injury	122	20.2
Capsulitis	87	9.5	Epicondylitis	51	8.4
Tenosynovitis	80	8.8	Tenosynovitis	42	7
SLAP	51	5.6	Strain finger joint capsule	37	6.1
Epicondylitis	50	5.5	Skin abrasions	34	5.6
Impingement (Shoulder)	40	4.4	Back problems	24	4
Strain finger flexor tendon	36	4	Knee injuries	14	2.3
Dupuytren's disease	30	3.3	Fractures	14	2.3
Strain finger joint capsule	25	2.7	Capsulitis	13	2.2
Ganglion finger flexor tendon	19	2.1	Ganglion finger flexor tendon	11	1.8

(Schöffl, Hochholzer, Winkelmann, Strecker, Dt.Z.f.Sportmed.2/2003 and Schöffl et al. 2014 in progress)

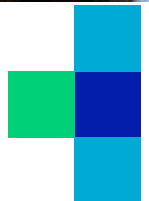


Differential diagnoses of finger injuries 2009 – 2012 (n=474) and 1998 – 2001 (247)

	2009 -	2012		1998 -	2001
Finger injuries (n=474)	n	%*	Finger injuries (n=247)	n	%*
Pulley injury	140	29.5	Pulley injury	122	49.4
Capsulitis	87	18.4	Tenosynovitis	42	17.0
Tenosynovitis flexor tendon	80	16.9	Strain finger joint capsule	37	15.0
Strain flexor tendon	36	7.6	Capsulitis	13	5.3
Strain finger joint capsule	25	5.3	Ganglion	11	4.5
Ganglion finger flexor tendon	19	4.0	Strain flexor tendon	7	2.8
Collateral ligament injury	17	3.6	Fracture	7	2.8
Epiphyseal fracture	16	3.4	Osteoarthritis	7	2.8
Lumbrical shift syndrome	15	3.2	Dupuytren	5	2.0
Osteoarthritis	14	3.0	Soft tissue injury	5	2.0
Extensor hood syndrome	7	1.5	Tendon rupture	4	1.6
Lumbrical tear	4	0.8	Collateral ligament injury	3	1.2
Snap finger	3	0.6	Osseous tear fibrocartilago palmaris	2	0.8
Cartilage injury	2	0.4	Epiphyseal fracture	2	0.8
Flip phenomena	2	0.4	Lumbrical shift syndrome	2	0.8
Broken osteophyte	1	0.2	Phlegmonia/Cellulitis	1	0.4
Avulsion fracture	1	0.2	Fingeramputation	1	0.4
Flexor contraction	1	0.2			
Rupture connexus intertendineus	1	0.2			
Enchondroma	1	0.2			
Contusion	1	0.2			
Tendon rupture	1	0.2			

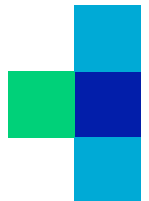
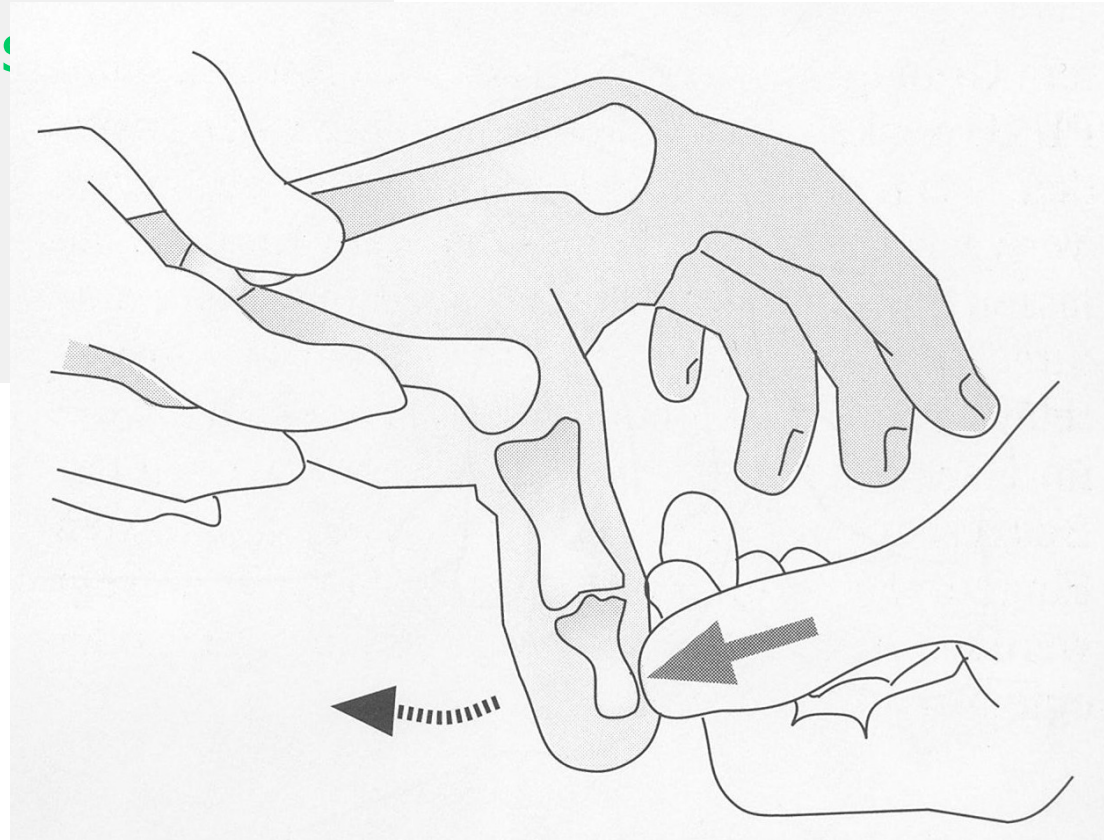


Crimping and Hanging Fingerposition



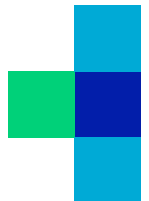
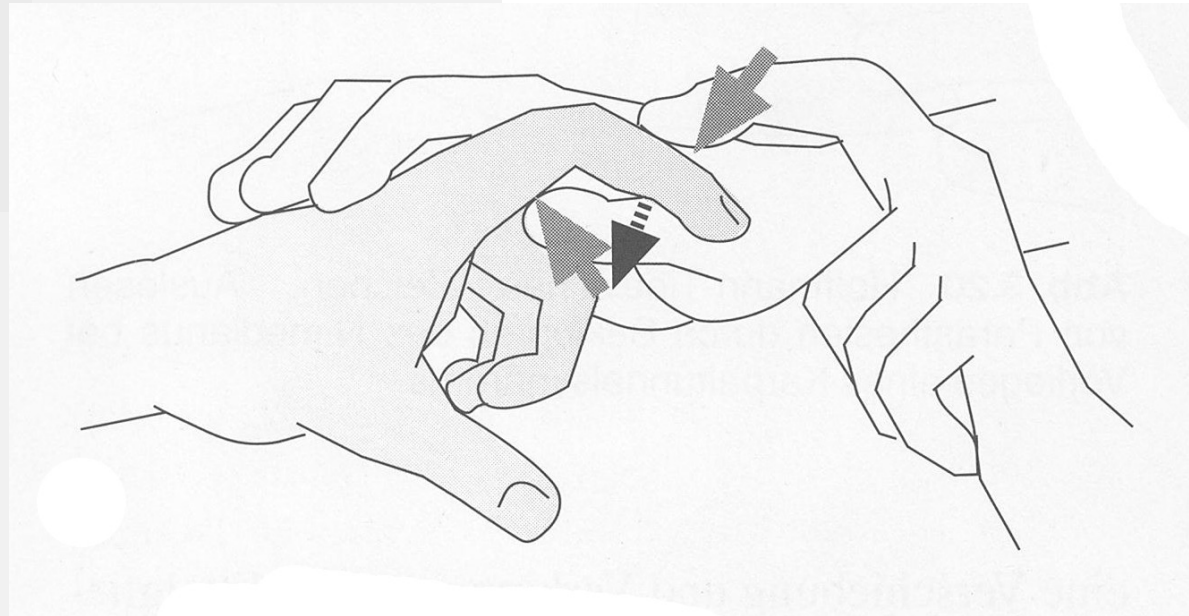
Finger Injuries: Clinical Examination

- Collateral ligaments
- Palmar plate
- FDP
- FDS
- Pulleys



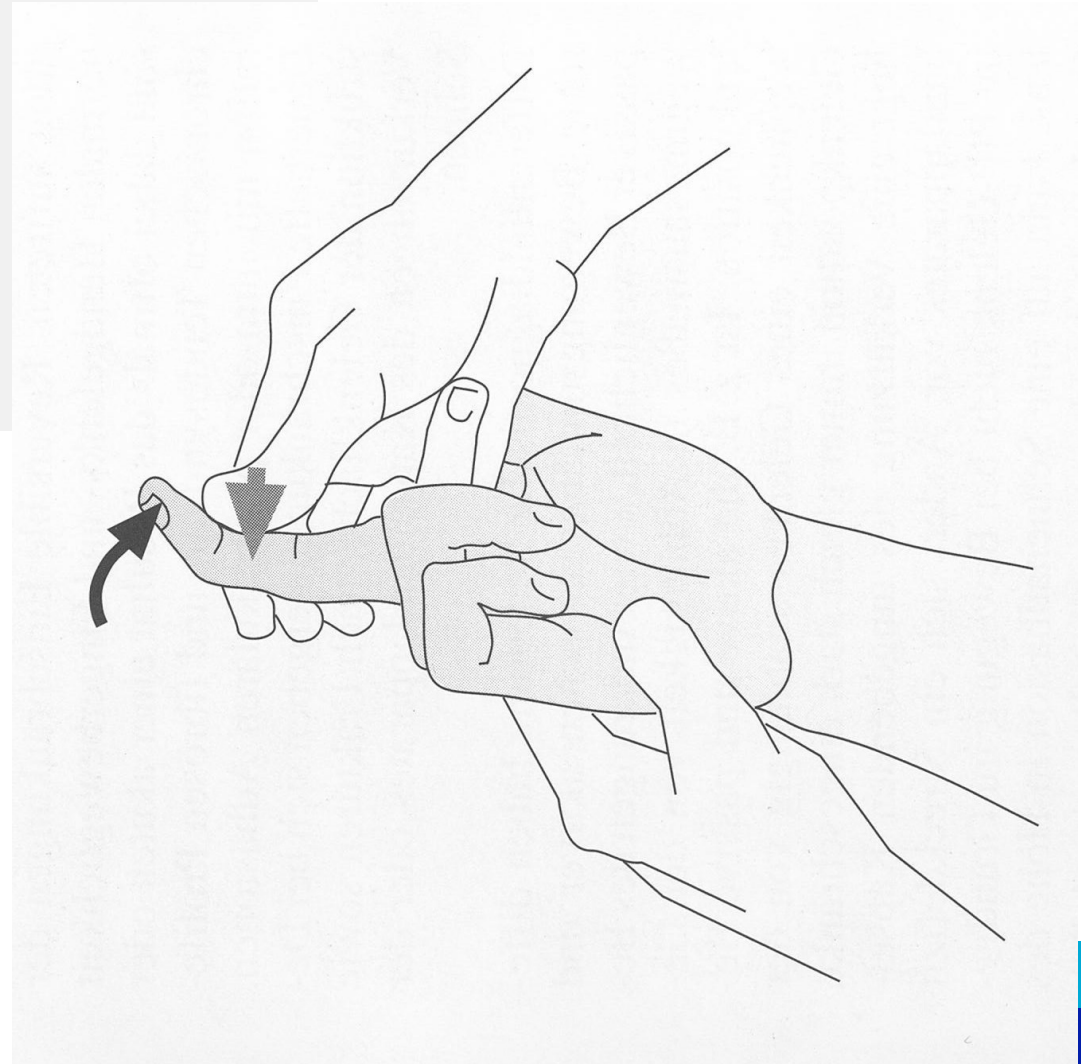
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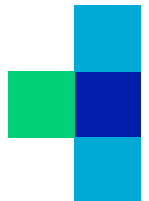
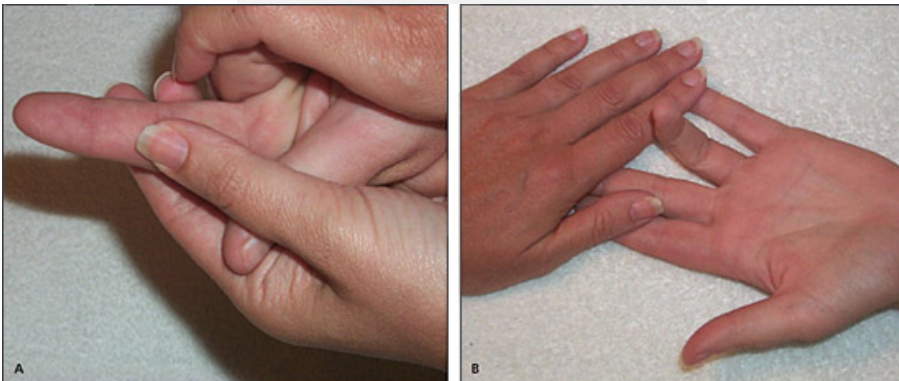
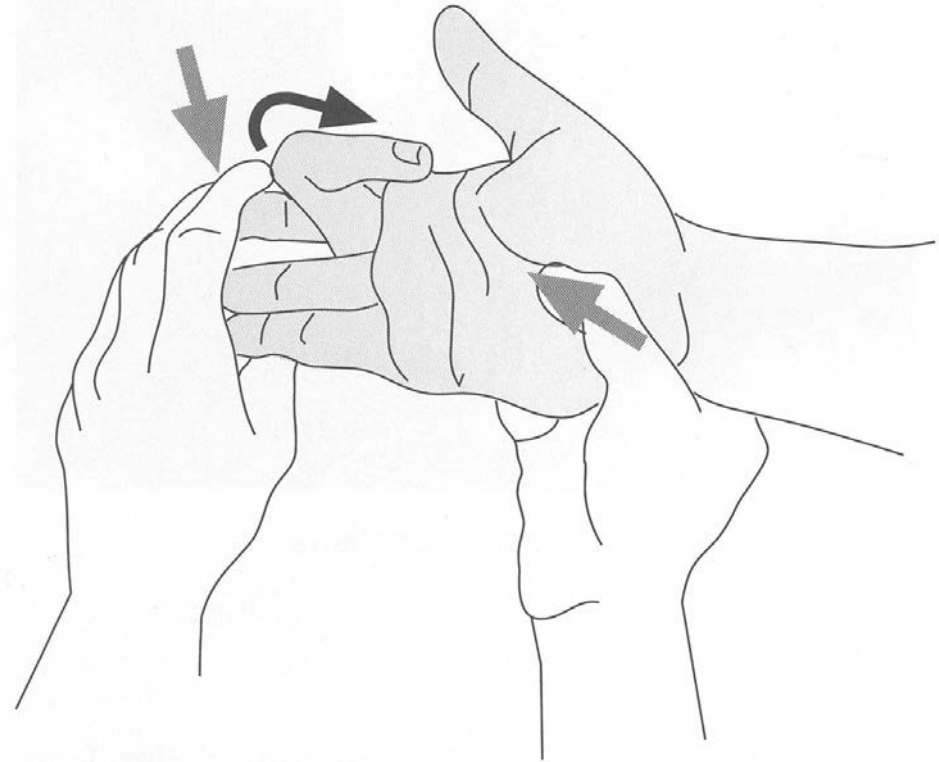


Erdoğan



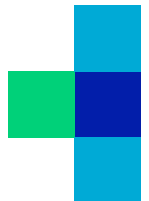
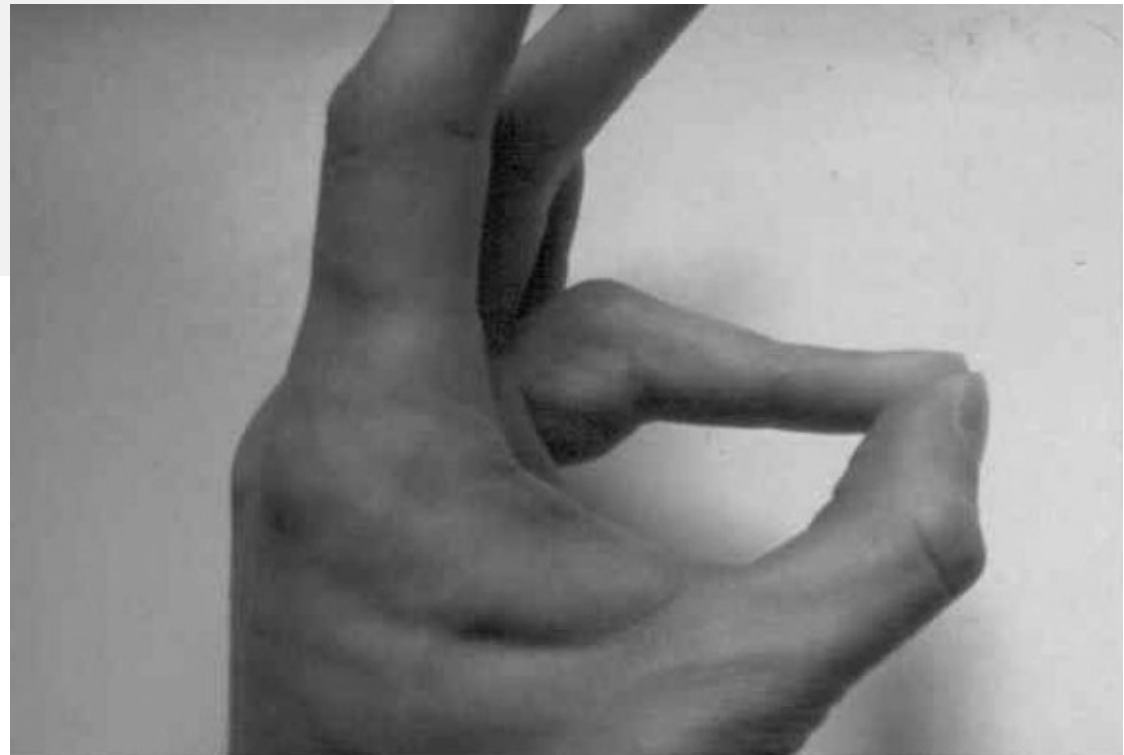
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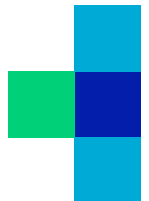
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Pulley Injury

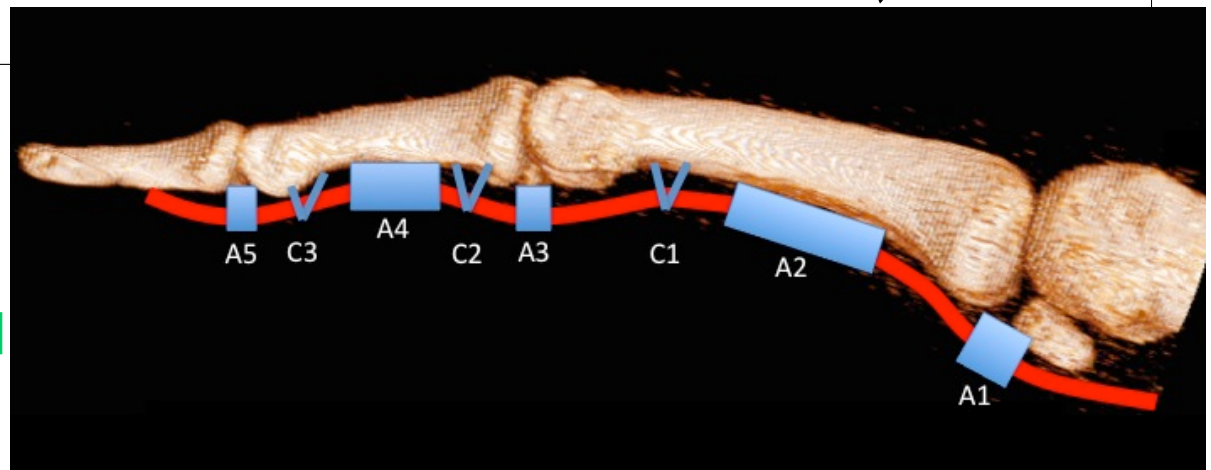
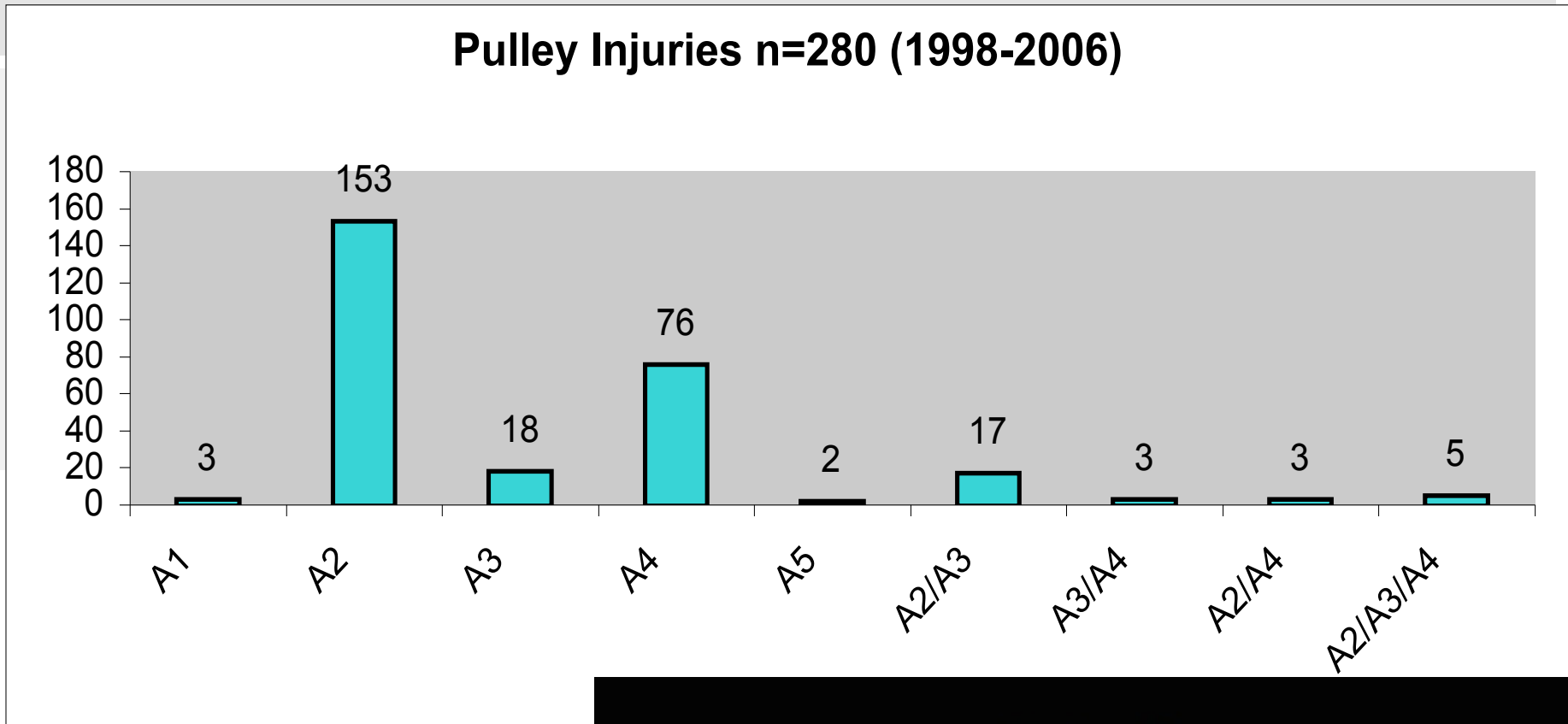
- Most frequent climbing injury.
- Firstly reported in rock climbing. (Bollen 1990 J Hand Surg [Br], Tropet 1990 J Hand Surg [Am])
- Plenty of scientific studies (Hochholzer et al. 1993, Moutet et al. 1993, 2003, Gabl et al. 1996, Schöffl et al. 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, Schweizer et al. 2003, etc.)
- Cause: mostly dynamic move in crimping position.
- Nowadays also seen in non-climbers. (Schöffl & Jüngert 2006, Jüngert, Neuhuber, Schöffl 2006)



Pulley Injury



Pulley Injury



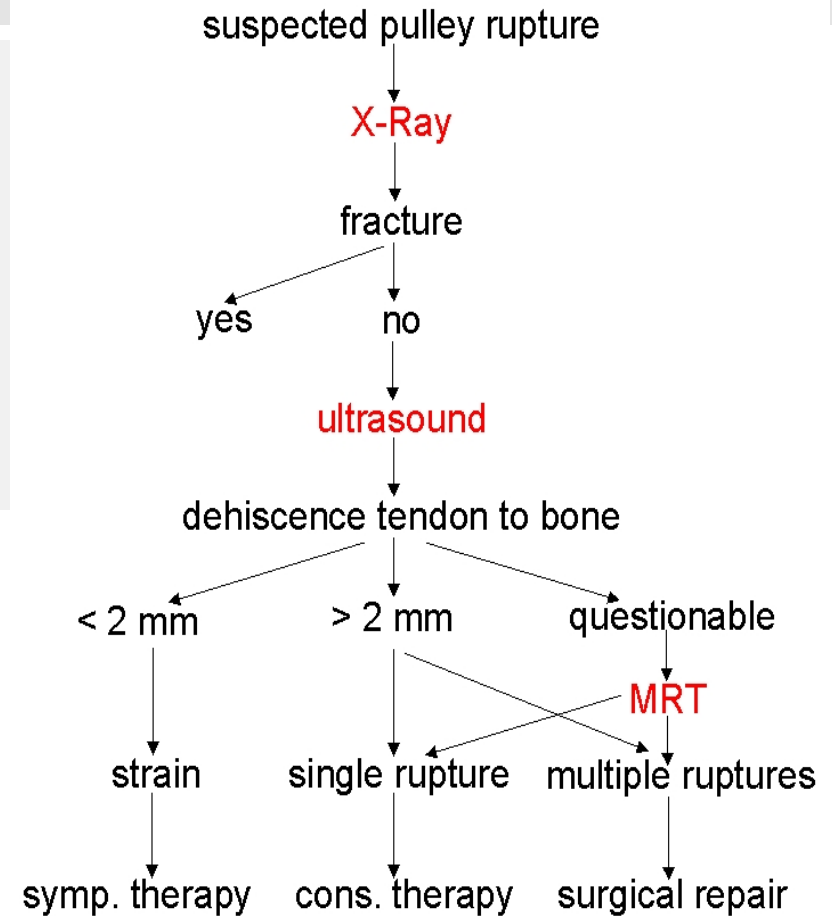
Schöffl, Schöffl: J Hand Surg [Am]



Pulley Injury: Diagnostics

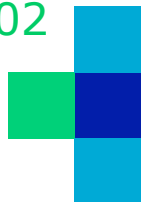
- History
- Clinics
- X-Ray
- Ultrasound
- MRi

Dehiscence of flexor tendon to bone (tb)

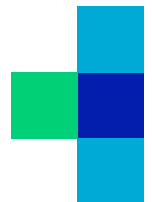


Schöffl et al. High Alt Med Biol 2002

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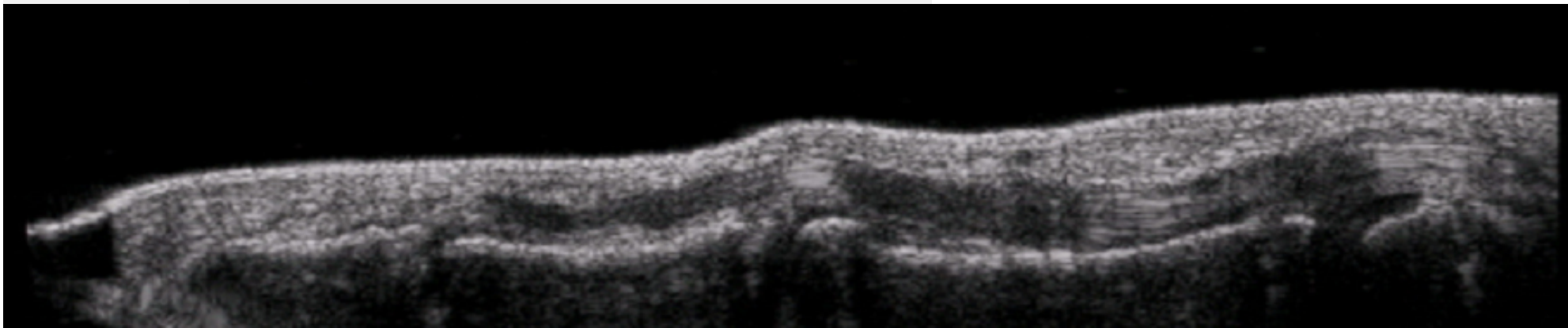


Pulley Injury: Clinical Picture - Bowstring

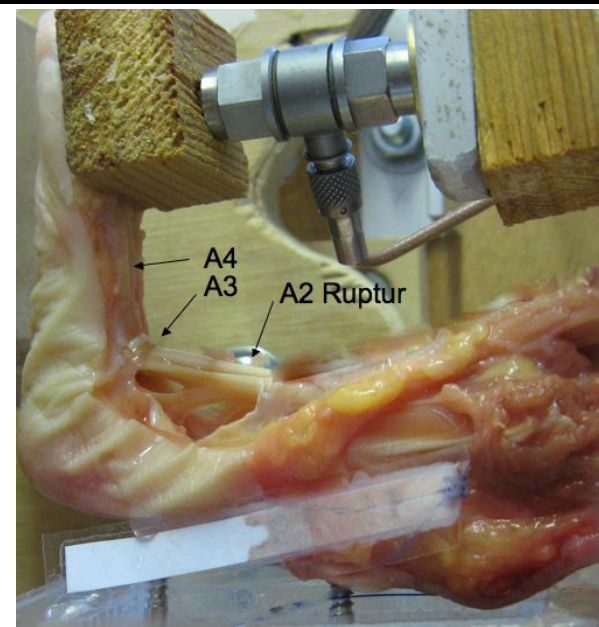
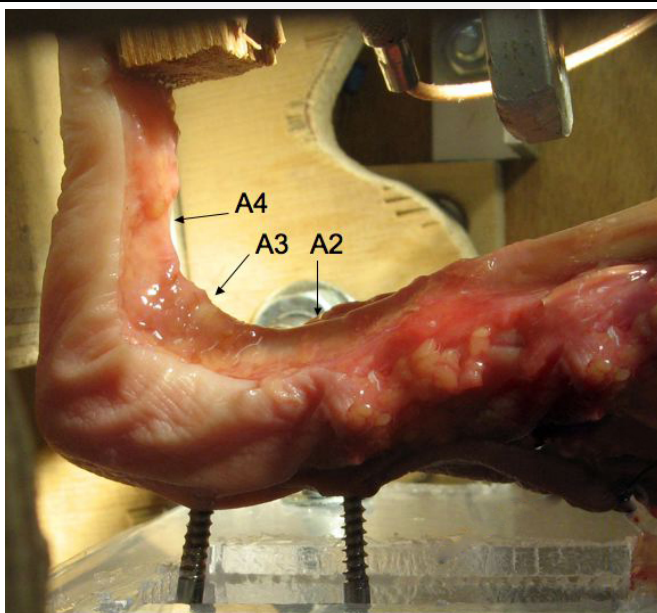
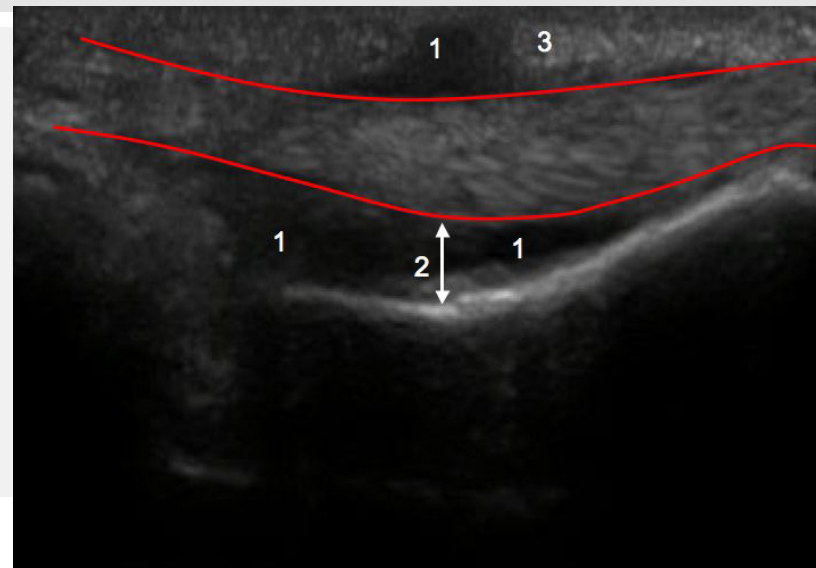
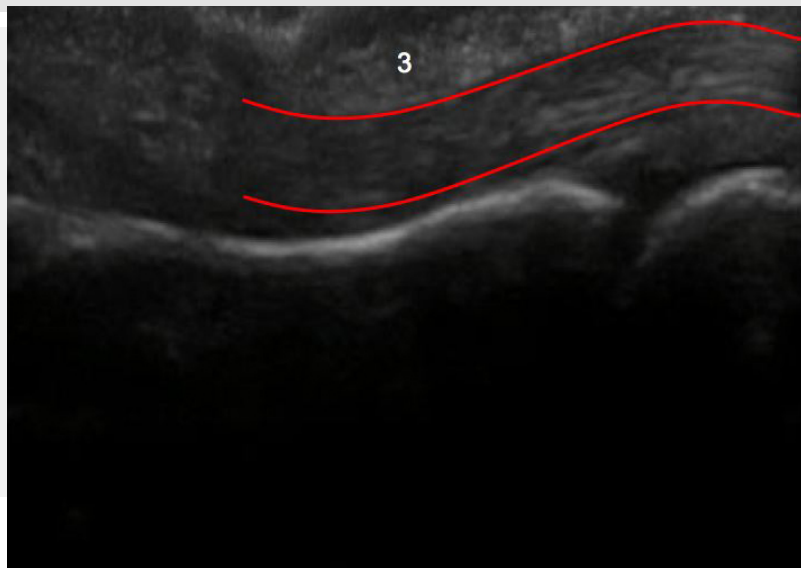




Pulley Injury: Ultrasound



Pulley Injury: Ultrasound



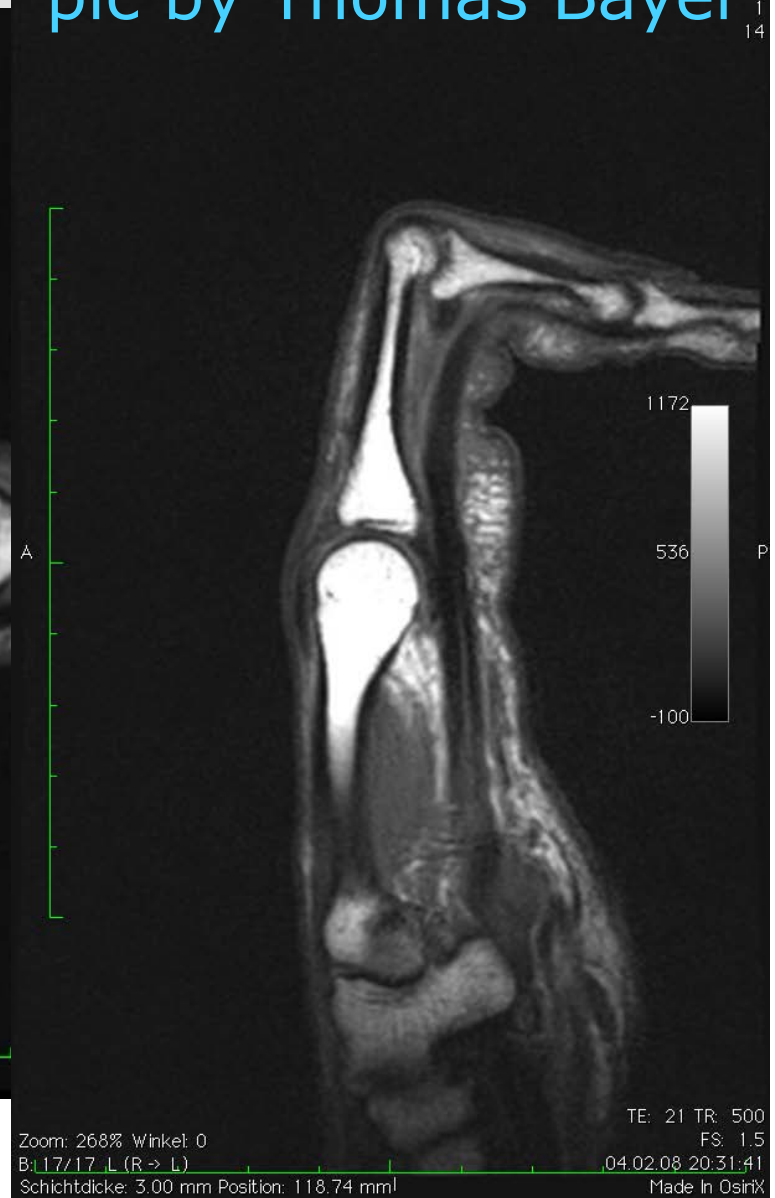
Pulley Injury: MRI

Bild-Größe: 228 x 301
Ansichts-Größe: 1038 x 625
WL: 610 WW: 1353



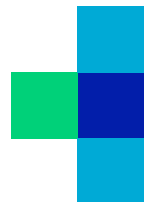
Bild-Größe: 612 x 1031
Ansichts-Größe: 612 x 1031
WL: 536 WW: 1271

pic by Thomas Bayer



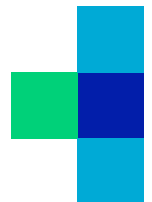
Pulley Injury: Grading

Grade	Injury
Grade I	Pulley strain (dehiscence of the flexor tendons to the bone < 2mm)
Grade II	Complete rupture of A4 or partly rupture of A2
Grade III	Complete rupture A2 or A3
Grade IV	Multiple ruptures, as A2/A3, A2/A3/A4 or single rupture (A2 or A3) combined with Mm. lumbricalis or collateral ligament trauma



Pulley Injury: Therapy

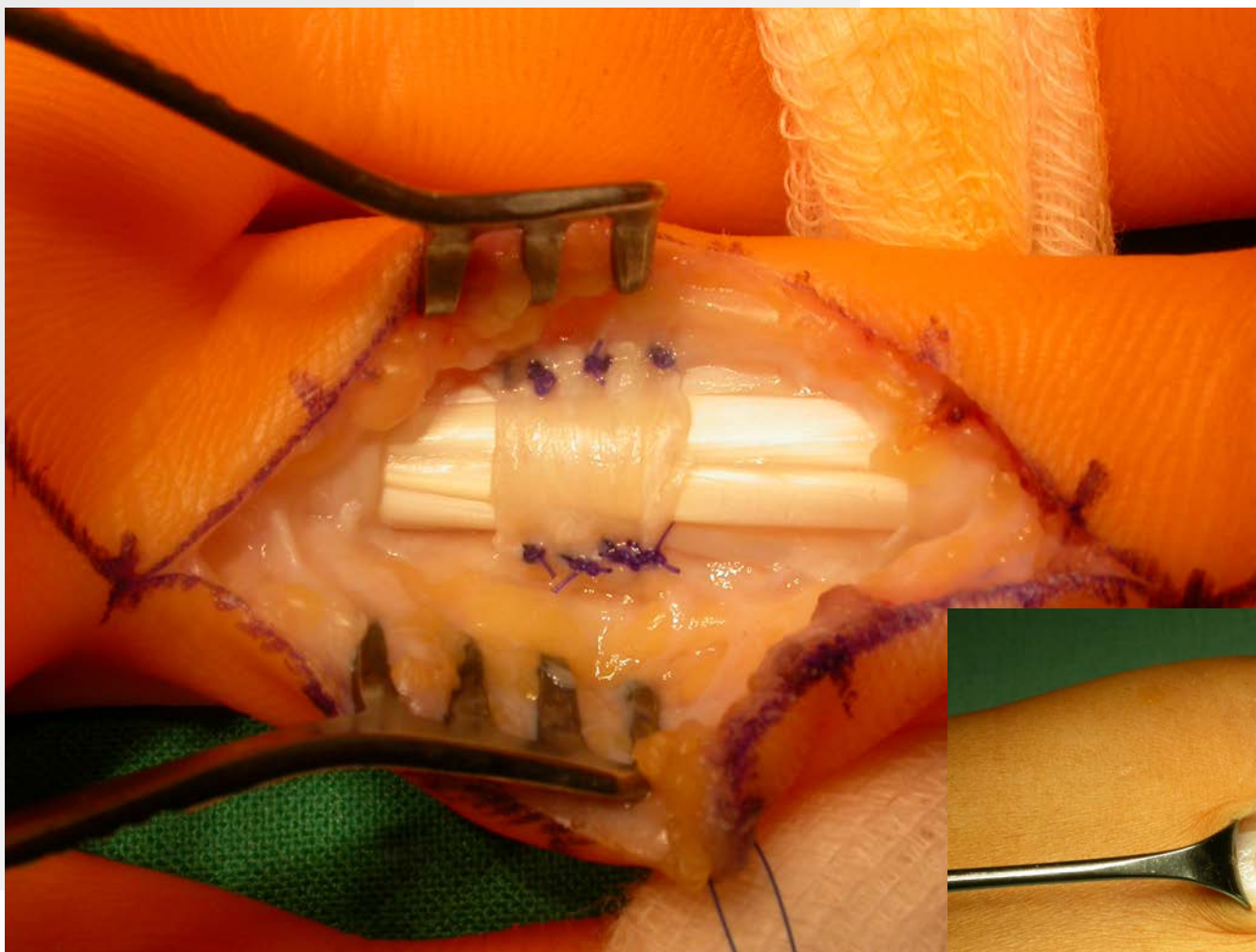
	Grade I	Grade II	Grade III	Grade IV
Injury	Pulley strain	Complete rupture of A4 or partly rupture of A2 or A3	Complete Rupture A2 or A3	Multiple ruptures, as A2/A3, A2/A3/A4 or single rupture (A2 or A3) with Lumbricalis or ligamental truma
Therapy	Conservative	Conservative	Conservative	Surgical Repair
Immobilisation	None	10 days	10-14 days	Postoperative 14 days
Functional therapy	2-4 weeks	2-4 weeks	4 weeks	4 weeks
Pulley protection	Tape	Tape	Thermoplastic ring Tape	Thermoplastic ring
Easy sportspecific activities	After 4 weeks	After 4 weeks	After 6-8 weeks	4 month
Full sportspecific activities	6 weeks	6-8 weeks	3 month	6 month
Taping through climbing	3 month	3 month	6 month	>12 month



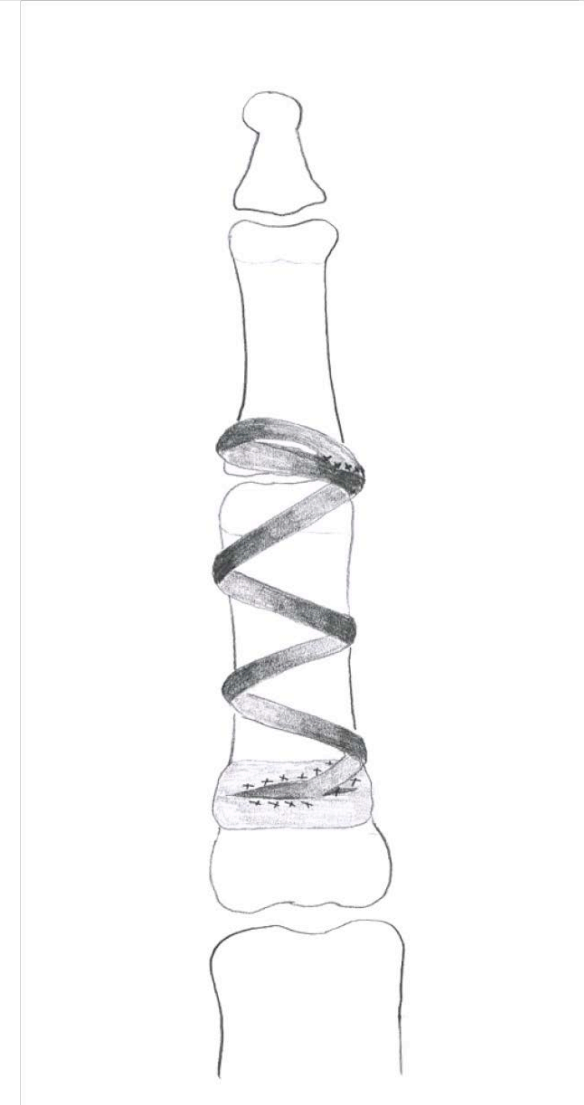
Pulley Injury: Surgical Graft



Pulley Injury: Surgical Graft – Retinakulum extensorum



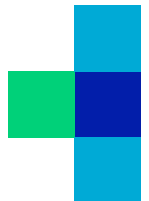
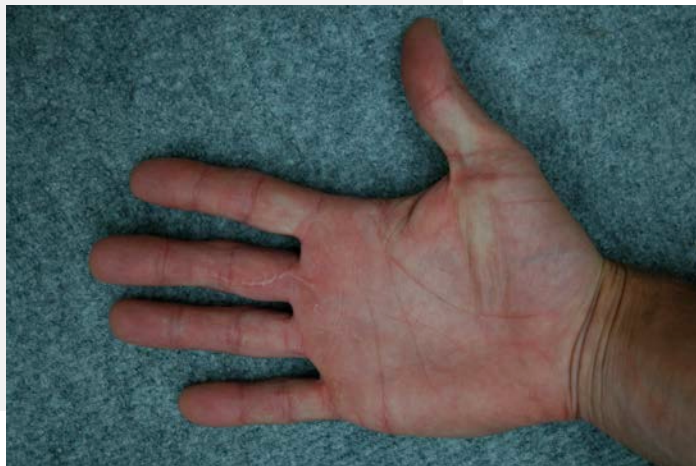
Pulley Injury: Surgical Graft – One and a half loop and Weilby's Repair – Bamberg Repair



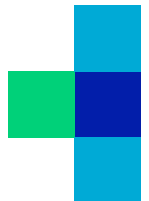
Schöffl et al. J Hand Surg Am 2012



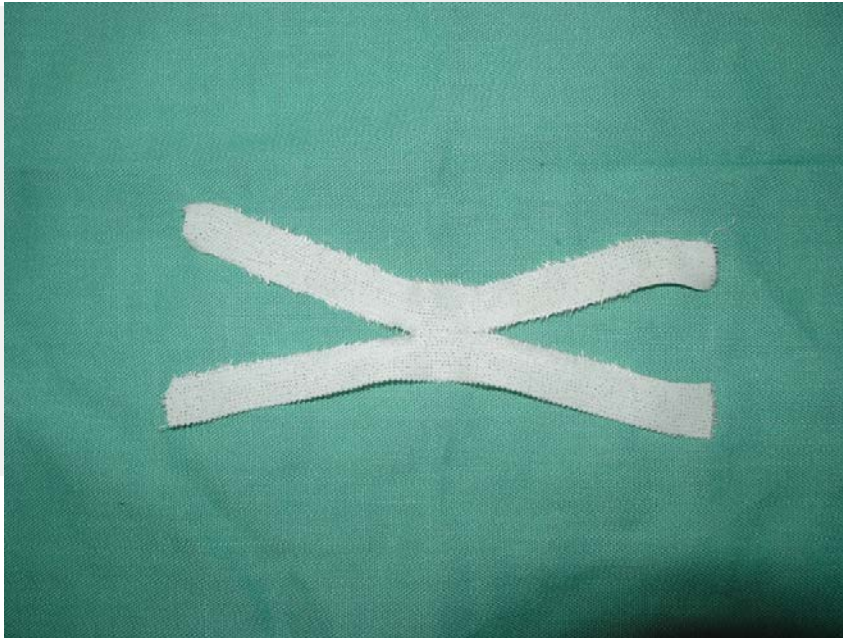
Pulley Injury: Surgical Graft – One and a half loop and Weilby 's Repair (S.A.14 m post op)



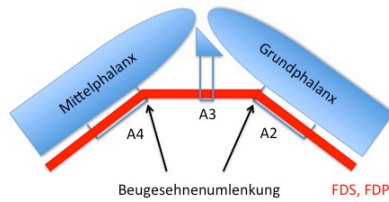
Pulley Injury: Pulley Support - Soft cast



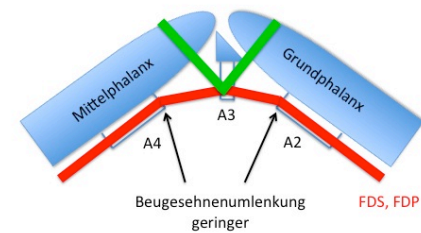
Pulley Injury: Taping - „Isa“-Tape



Beugesehnenumlenkung in der aufgestellten Position



Beugesehnenumlenkung in der aufgestellten Position mit H-Tape



Pulley Ruptures Outcome

- 122 Pulley Ruptures:

81 Grade 1-3 re-evaluated:

80 no symptoms, 1 operative tenosynovektomy and pulley repair.

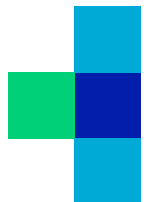
All are climbing again.

7 Grad 4: (surgery): Buck-Gramcko Score very good 4, good 2, fair 1

Schöffl et al. Hand Mikro Plast Chir 2004

- No strength deficit in the former injured finger (cons.Tx). (21 patients with 27 pulley ruptures).

Schöffl et al. Med Sci Spo Exerc 2006

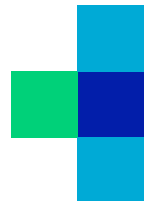


Pulley Ruptures Outcome: „Bamberg“-repair

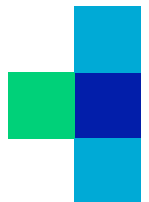
Pulley Injuries 1998-2010 (n=462)

	N	Right	Left	M	F	D2	D3	D4	D5	A1	A2	A3	A4	A5	A2/A3	A3/A4	A2/A4	A2/A3/A4	C1	C2	C3
Pulley strain	118	63	55	101	17	4	50	62	2	3	68	9	37	1	0			0			
Pulley rupture	344	176	168	293	51	8	122	204	10	7	140	13	121	1	27	5	4	11	13	1	1

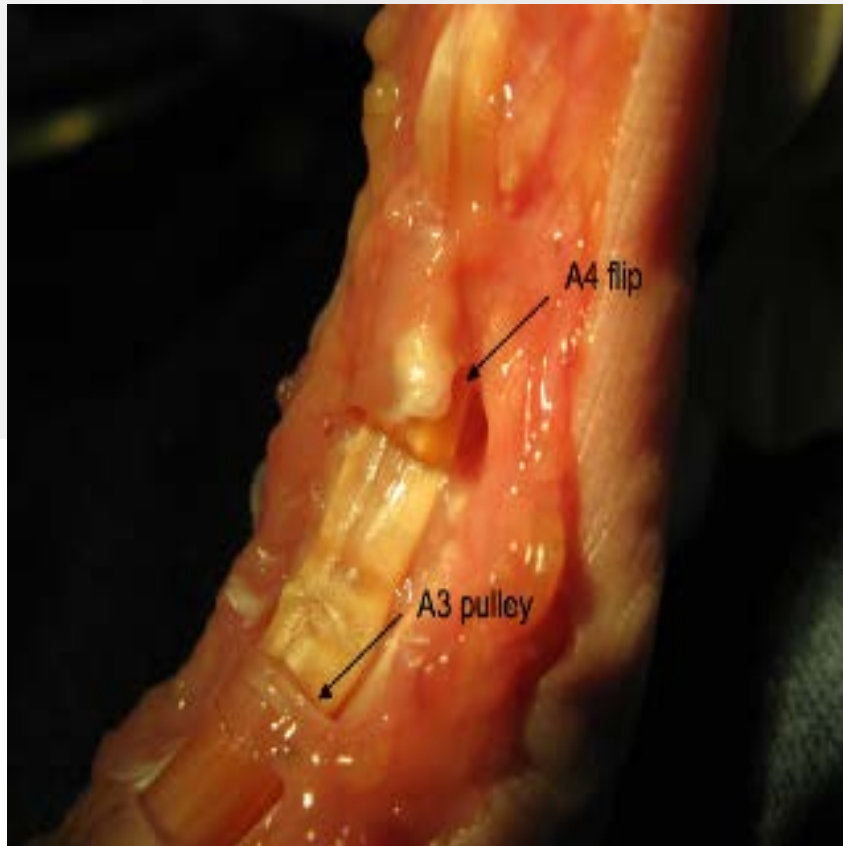
Handedness	Pulley rupture	Presurgical extension deficit PIP or DIP joint	Re-evaluation after	Postsurgical extension deficit PIP or DIP joint	Initial climbing level (UIAA metric-scale [30])	Outcome Buck-Gramcko Score [28]	Climbing level after the healed injury (UIAA metric-scale [30])	Functional outcome Schöffl Score [31]	Sport-specific outcome Schöffl Score [31]
right	A2/3/4	10° PIP	18 months	10° PIP	6.5	15	6.5	good	excellent
right	A2/3	10° PIP	19 months	10° PIP	9.7	15	9.7	good	excellent
right	A2/3	5° PIP	18 months	5° PIP	7.3	15	6.7	good	excellent
right	A2/3/4	20° PIP	12 months	30° PIP	6.7	15	5.0	fair	satisfying
right	A2/3/4	25° PIP	52 months	25° PIP	7	15	7	satisfying	excellent
right	A2/A3	10° PIP	6 months	10° PIP	8.7	15	8.7	good	excellent



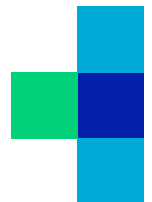
Neglected Injuries: diagnosed as A2, in reality A2,3,4



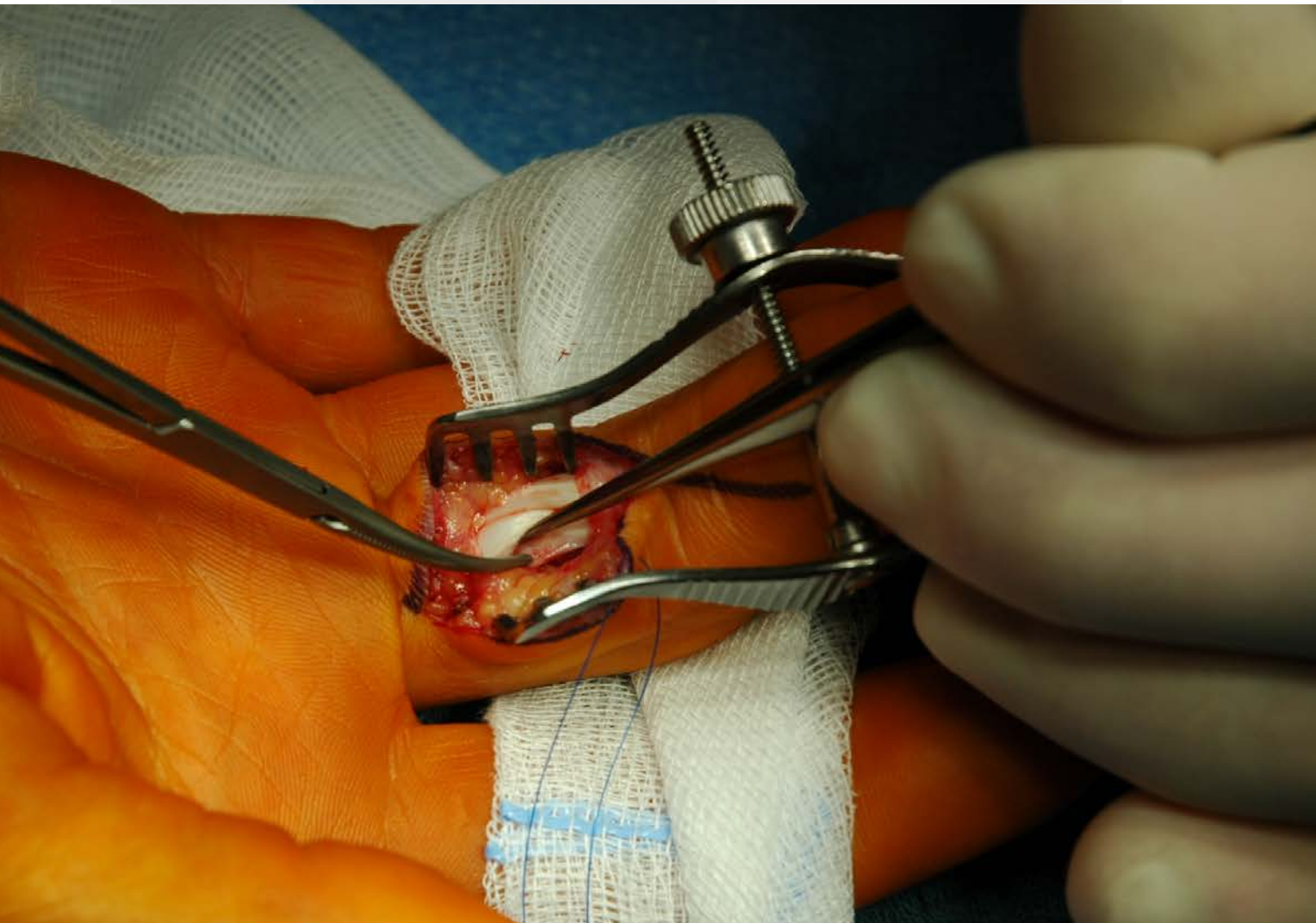
Pulley Ruptures: Chronic tenosynovitis - FLIP (Flap irritation phenomenon)



Schöffl et al. 2010



Pulley Ruptures: Chronic tenosynovitis - FLIP (Flap irritation phenomenon)



Joint Capsular Injury



Joint Capsular Injury

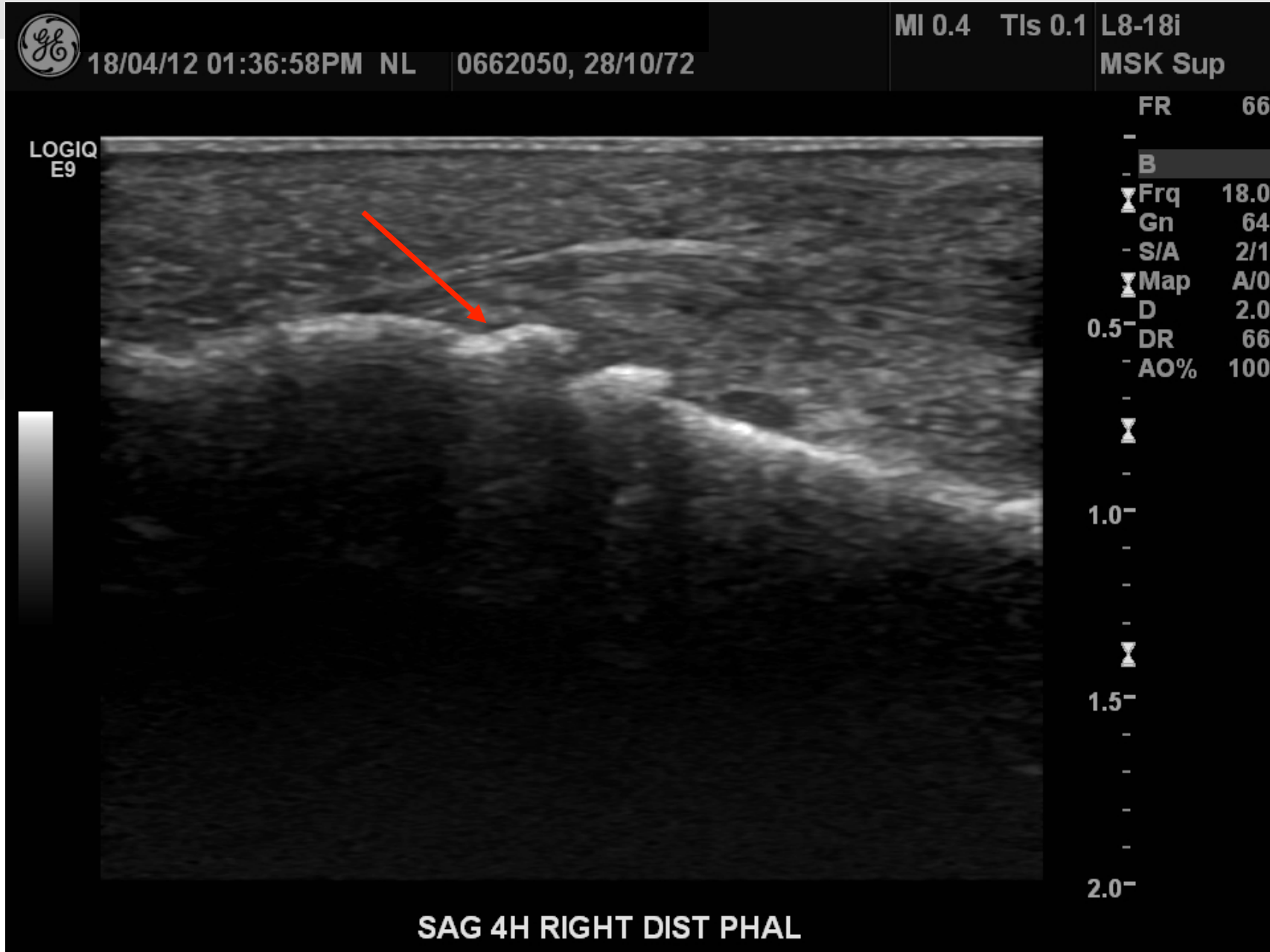


Joint Capsular Injury

- Overstrain, partial or complete rupture, # palmar plate
- Initial Tx: **RICE**, finger compression
- immobilisation
- Early functional tx.
- NSAID, physiotherapy
- Finger exercises
- Tape



Joint Capsular Injury



Joint Capsular Injury

- Overstrain, partial or complete rupture, # palmar plate
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- Rest
- Ice
- Compression
- Elevation

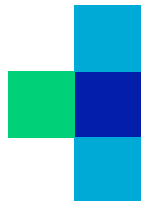


Joint Capsular Injury

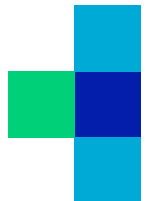
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Joint Capsular Injury: Taping



Joint Capsular Injury: Taping

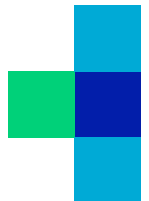


Chronic Capsular Damage – Neglected Injuries

- Reduced range of motion, morning stiffness
- X ray
- 32/75 climbers with swellings of the finger joints (Hochholzer et. al. 1993)
- Reversible if detected early (GJNT)
- Tx: stress reduction, movement, prophylaxis externa (sulphur), RSV

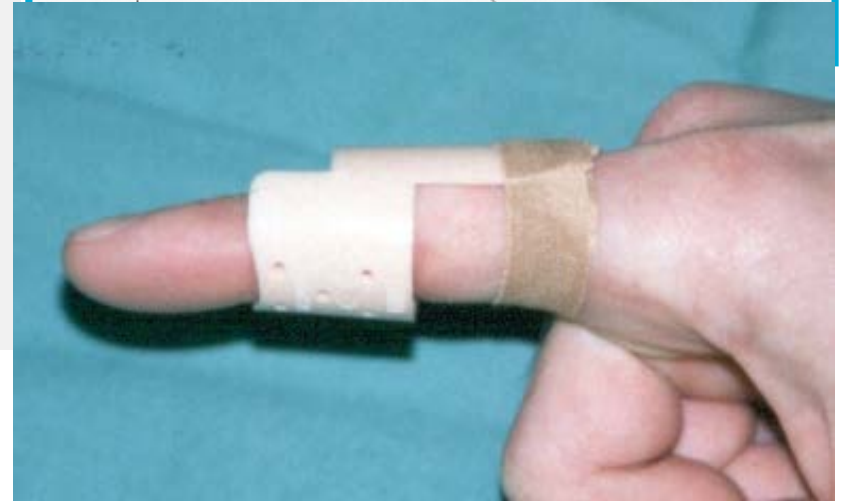
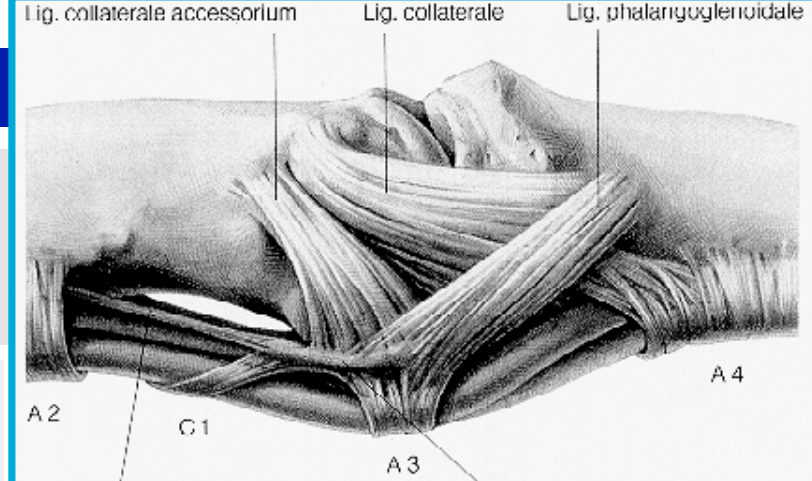


Injury of Collateral Ligaments



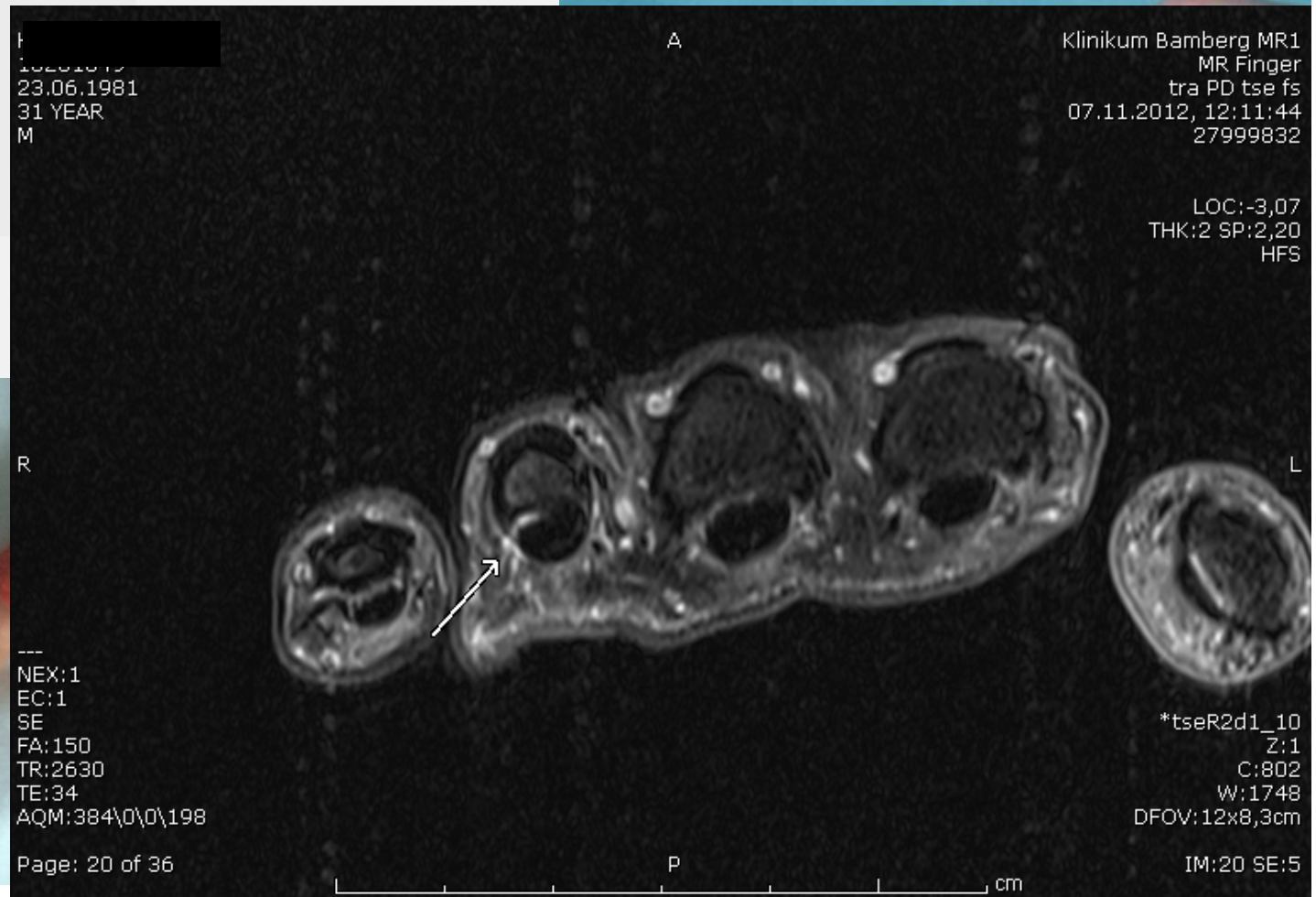
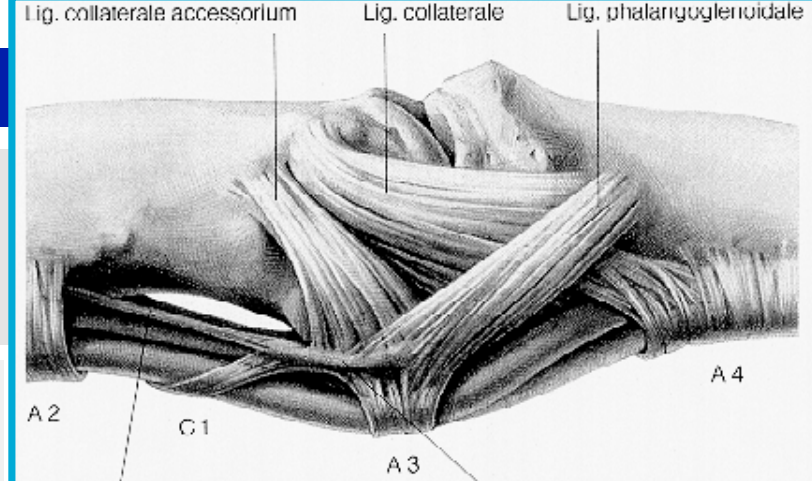
Injury of Collateral Ligaments

- Osseous injury
- Instability
- Cons.Tx
- Rarely surgery



Injury of Collateral Ligaments

- Osseous injury
- Instability
- Cons.Tx
- Rarely surgery



Tendonitis - Tenosynovitis - Tendovaginitis



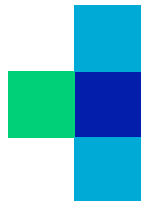
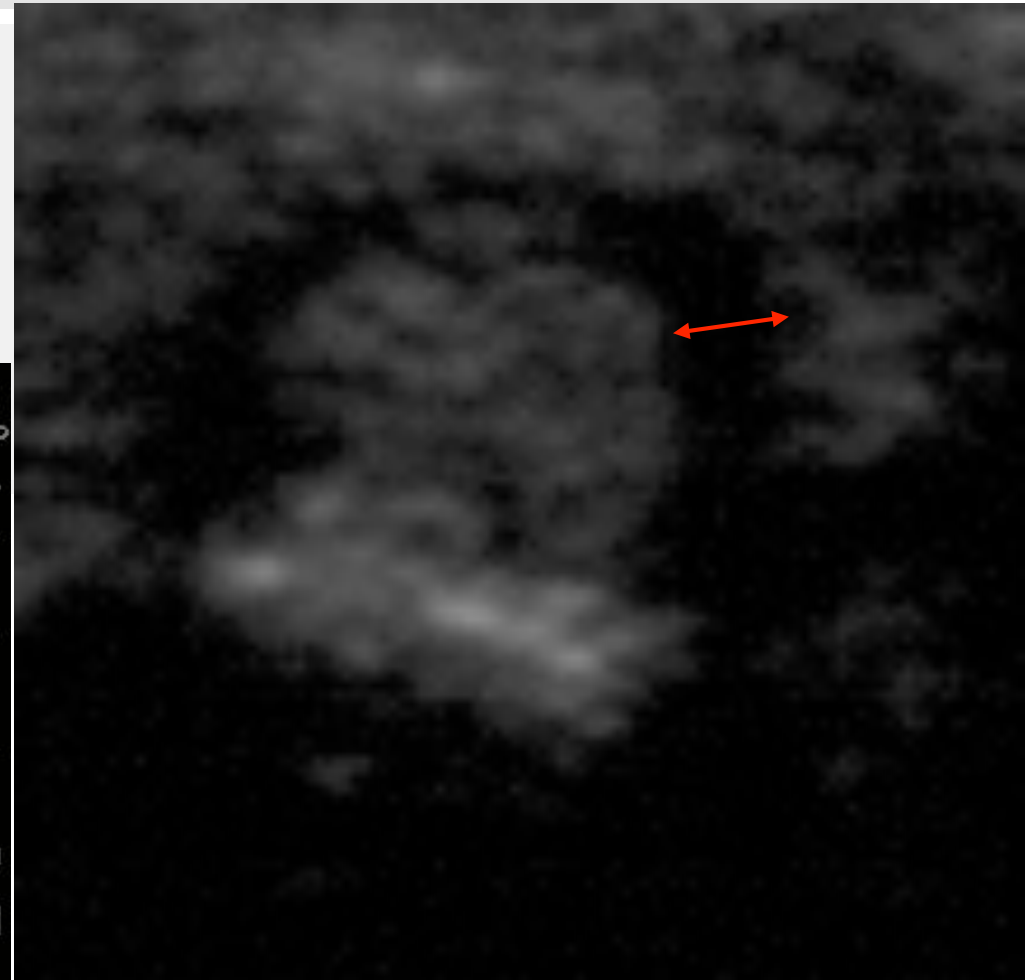
Tendonitis: Cause, Symptoms

- Crimping Position
- „Sloper“
- Pressure tenderness b
phalanx palmar
- Swelling, rush,
hyperthermia



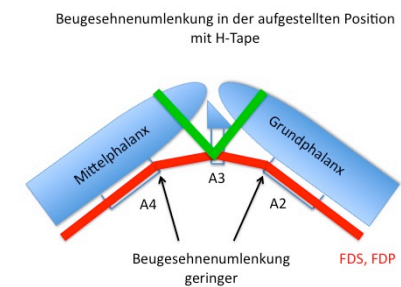
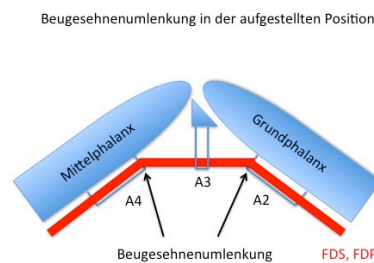
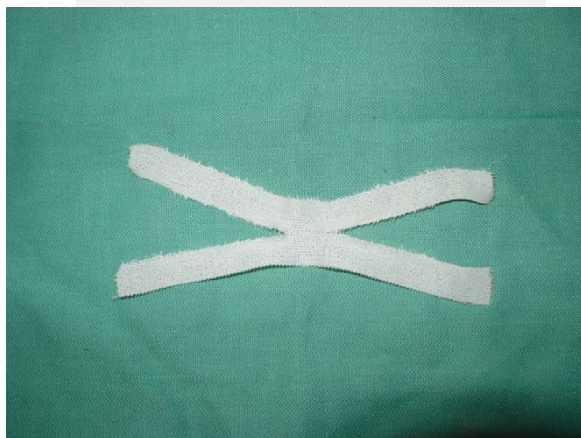
Tendonitis: Diagnosis

- Clinical
- Ultrasound
- MRI



Tendonitis: Therapy

- Stress reduction
- Splint immobilisation
- NSAD, enzymes
- lokal injections (steroids, hyaluronic acid)
- Ice therapy, brush massages
- Sulphur baths
- Tape for climbing



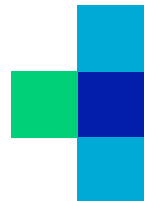
M. Dupytren

- Disease of the palmar aponeurosis
- 40-60 J
- Increased numbers in climbers, already in young age
- Chronic microtrauma
- Cons. Tx, rarely surgery, radiation tx

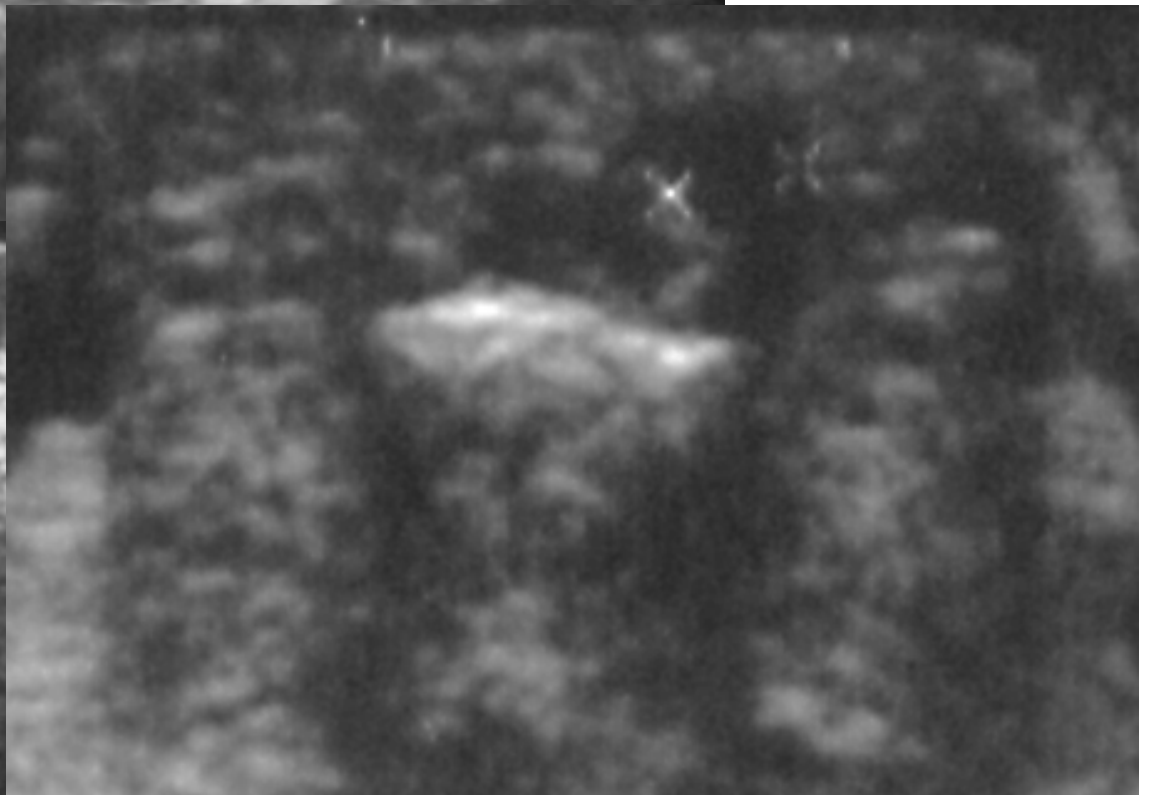
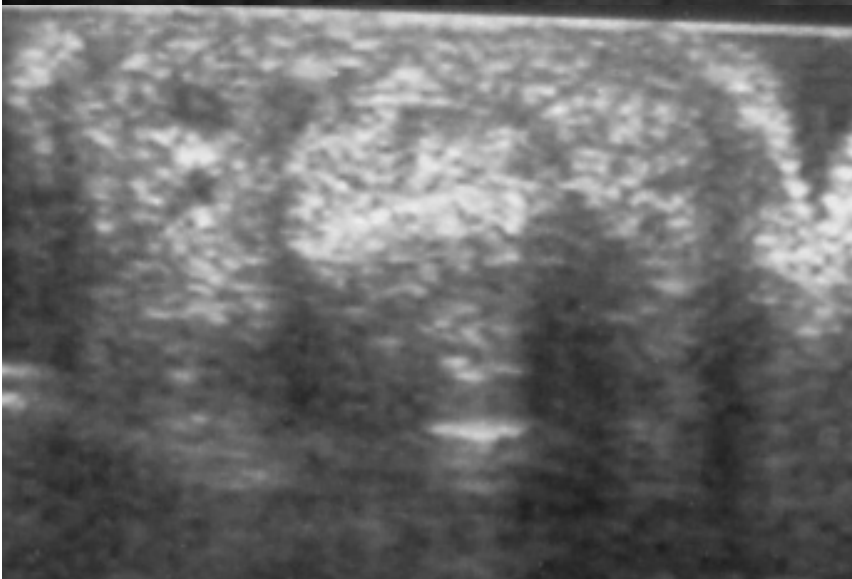
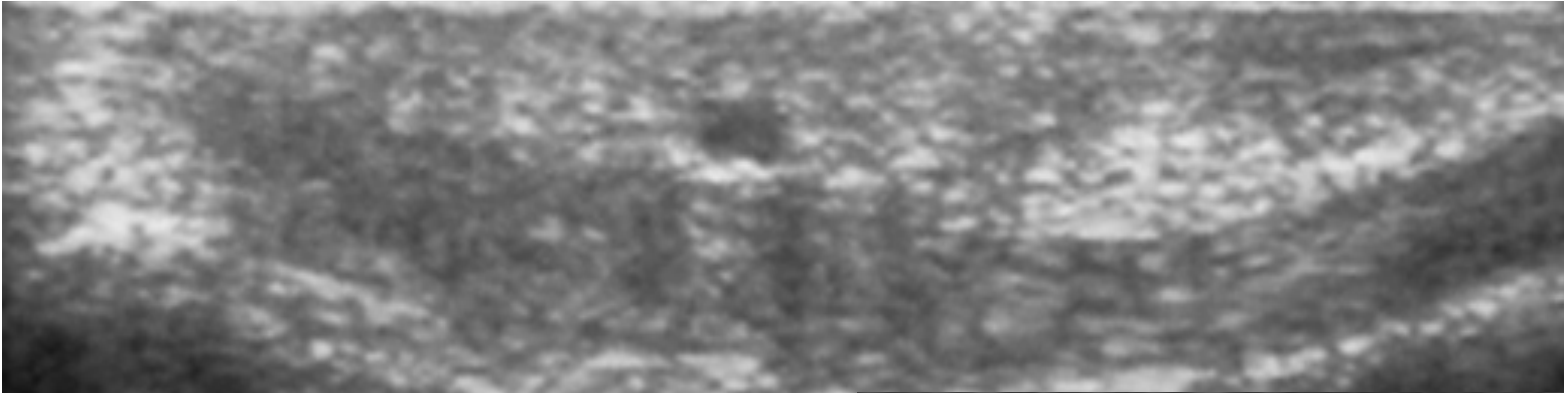


Ganglions

- Tendon sheath or pulley
- Tx. Cons, local steroids, rarely surgery



Ganglion



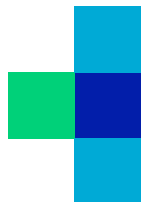
Fractures



Stress/Fatigue Fractures of the Epiphysis

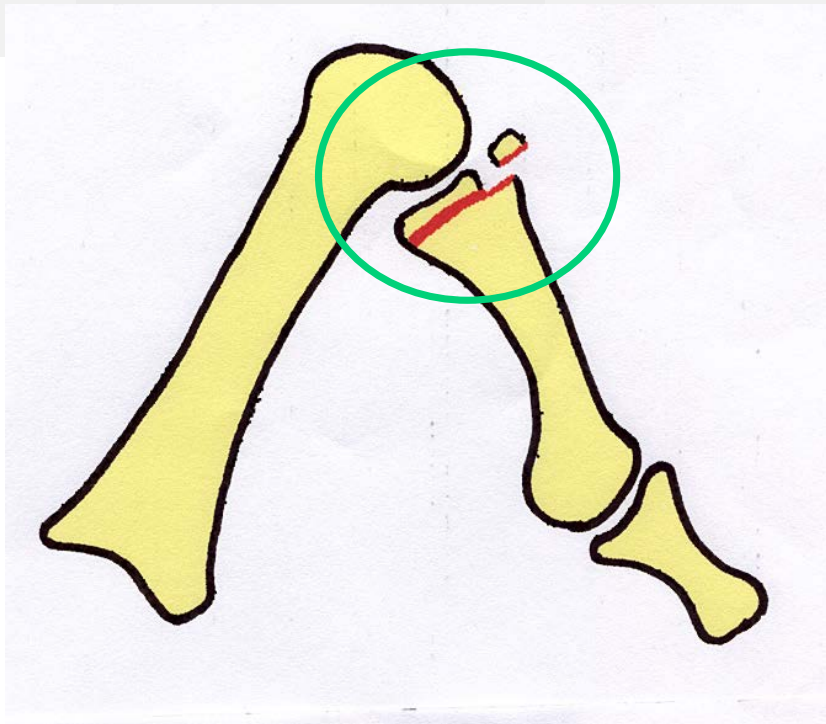
- 1997 firstly reported. Hochholzer, Schöffl et al. *Sport Ortho Trauma*
- Increasing number: we treated > 100 junior high level climbers
(Age MW = 13,4) (FRG, Austria, UK, Netherlands, USA, Brasilia, Tschechia, Slovakia, ...)

Hochholzer, Schöffl et al. *Sport Ortho Trauma* 2002, *Wild Env Med* 2005



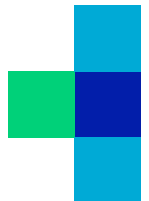
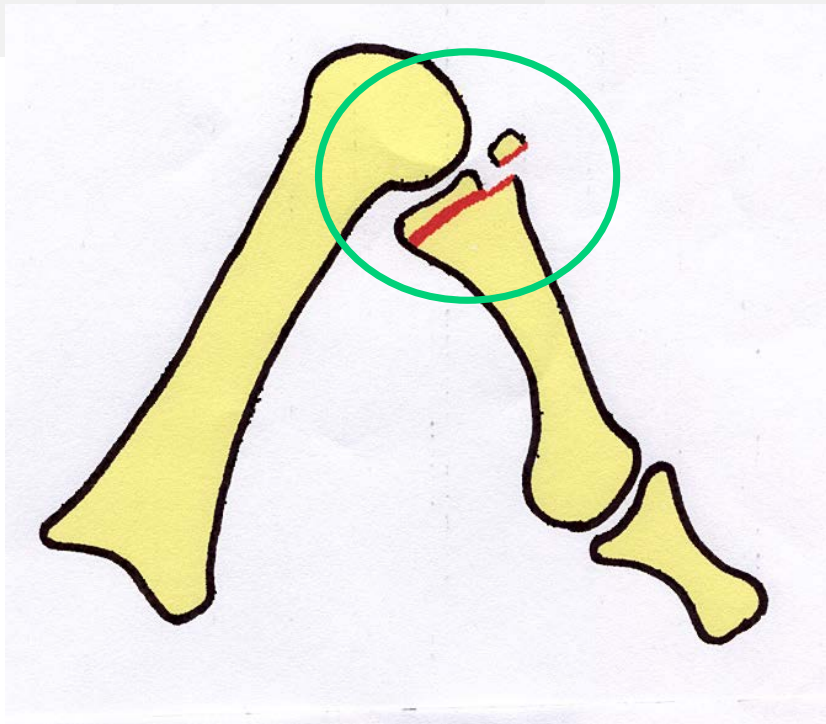
Stress/Fatigue Fractures of the Epiphysis

- Non traumatic epiphyseal fractures
Aitken II, S-H III.

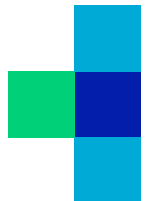


Stress/Fatigue Fractures of the Epiphysis

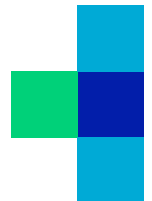
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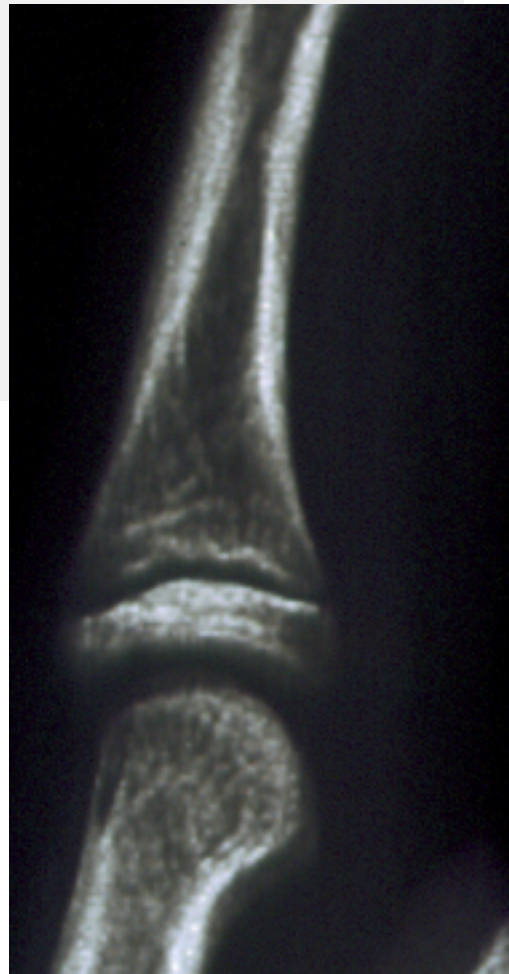
Stress/Fatigue Fractures of the Epiphysis



Stress/Fatigue Fractures of the Epiphysis: Course



Stress/Fatigue Fractures of the Epiphysis: Early diagnosis !!!



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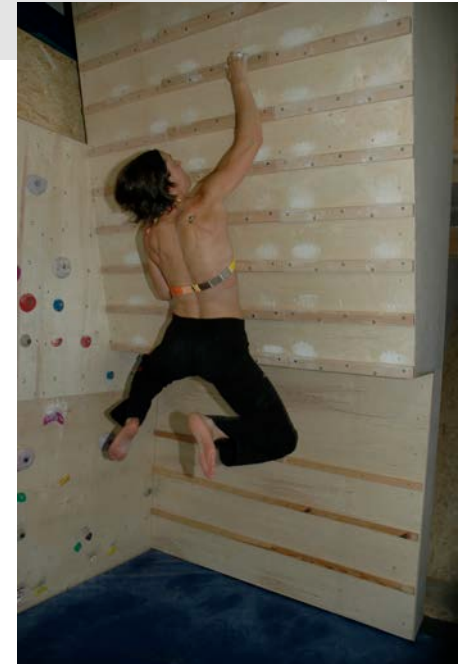


Stress/Fatigue Fractures of the Epiphysis: Therapy

- Rest (8w, than controll MRI)
- Immobilisation if necessary
- Surgery

■ PREVENTION !

Schöffl et al. (MedCom UIAA) 2004



Stress/Fatigue Fractures of the Epiphysis: Rule of thumb

hkäß, Paul
512
1997
AR

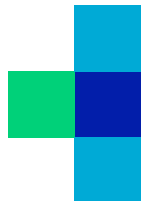


- Rule of thumb:
- For **coaches**: if a young climber 12-16 y has pain in the fingers after training or in the morning without trauma: rest for 1 week, if does not resolve see competent doctor
- For **doctors**: unclear finger pain/swelling of more than one week without trauma in young climbers 12-16y must get MRI by competent radiologist

C: 1812
W: 5500

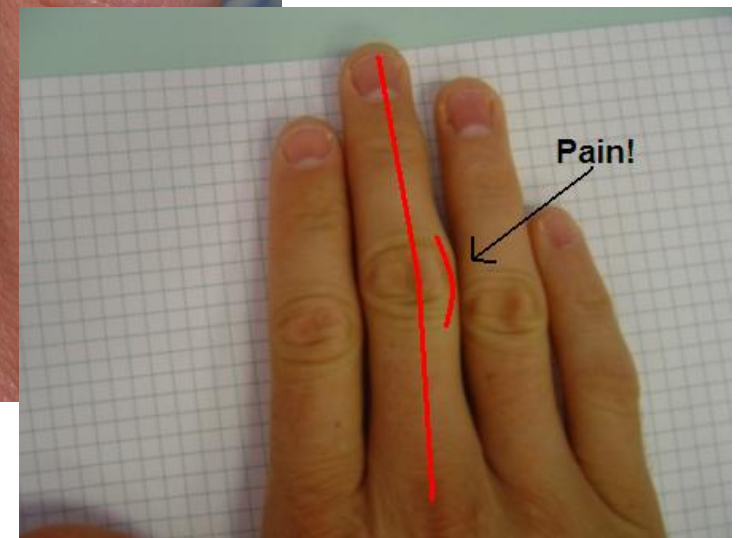


5 year follow up after epiphyseal fracture



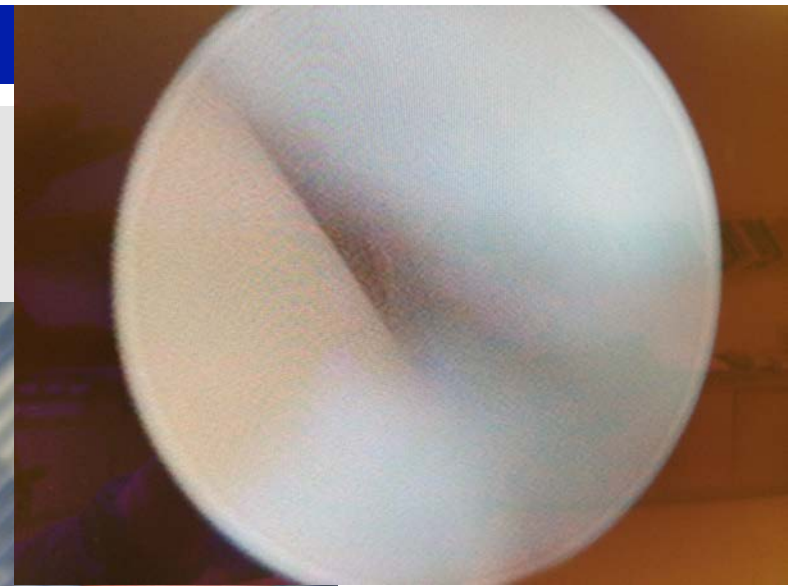
Capsulitis

- Cons Tx
- Externals
- NSAIDs
- Sulphur
- Injections
- RSO
- Ammoniumbituminosulfonat (20%) (ICHTHOLAN)

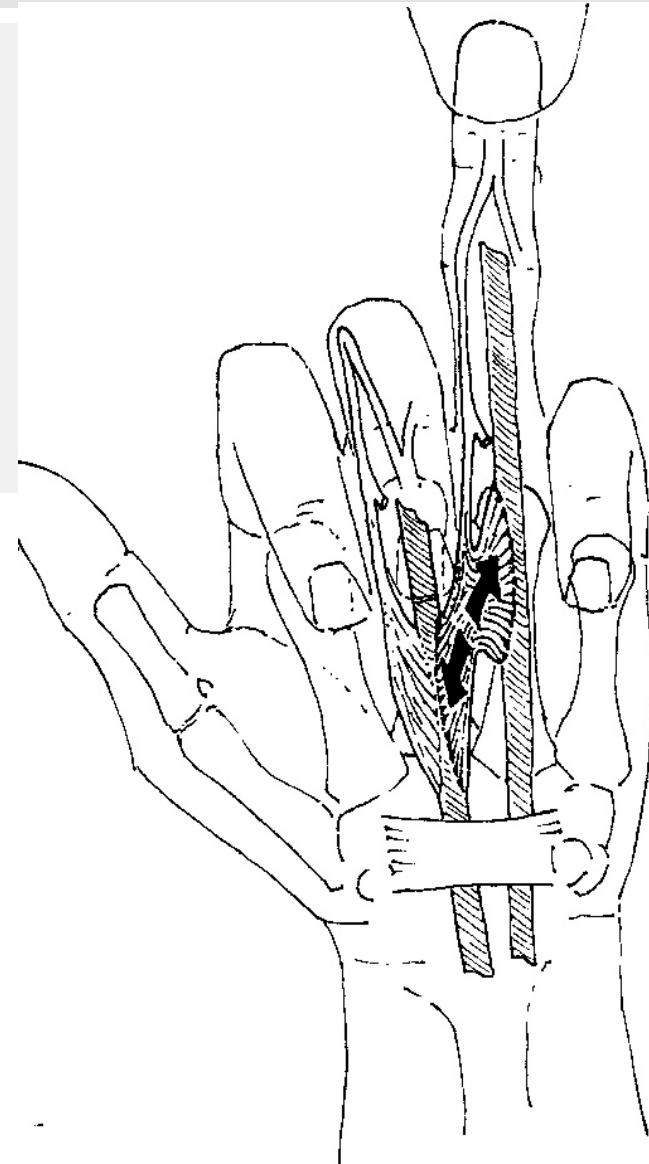
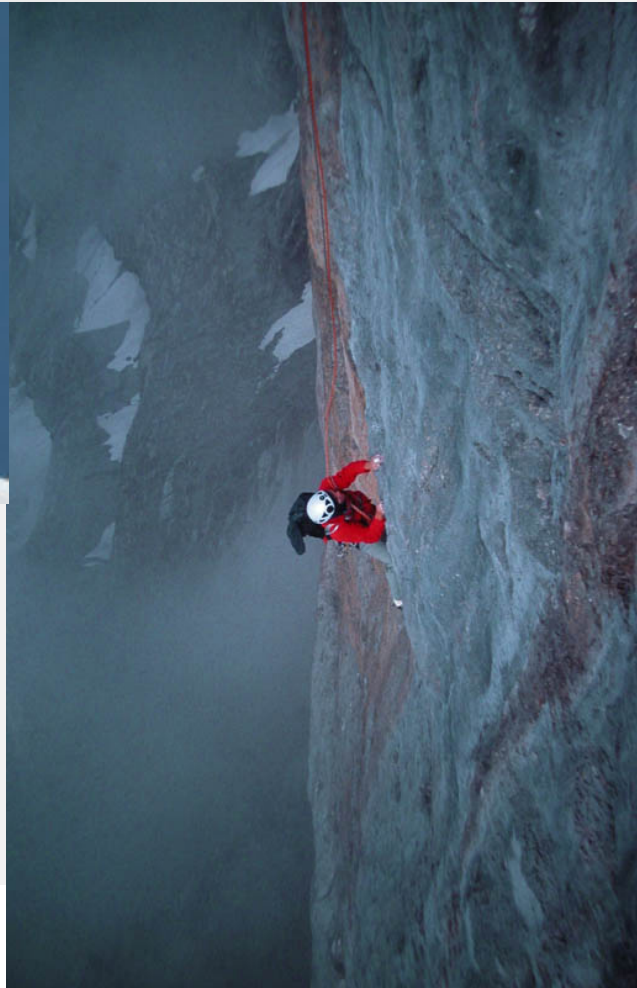


Capsulitis

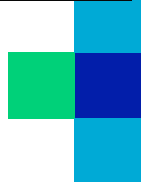
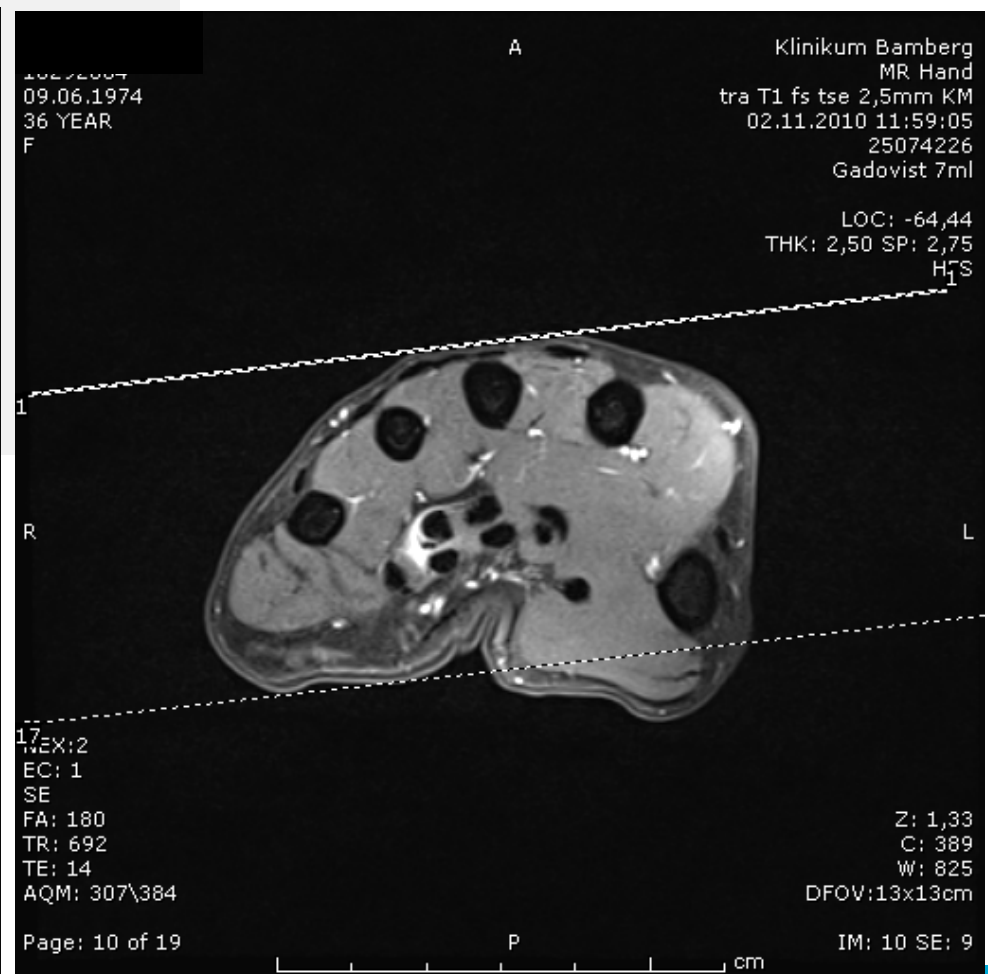
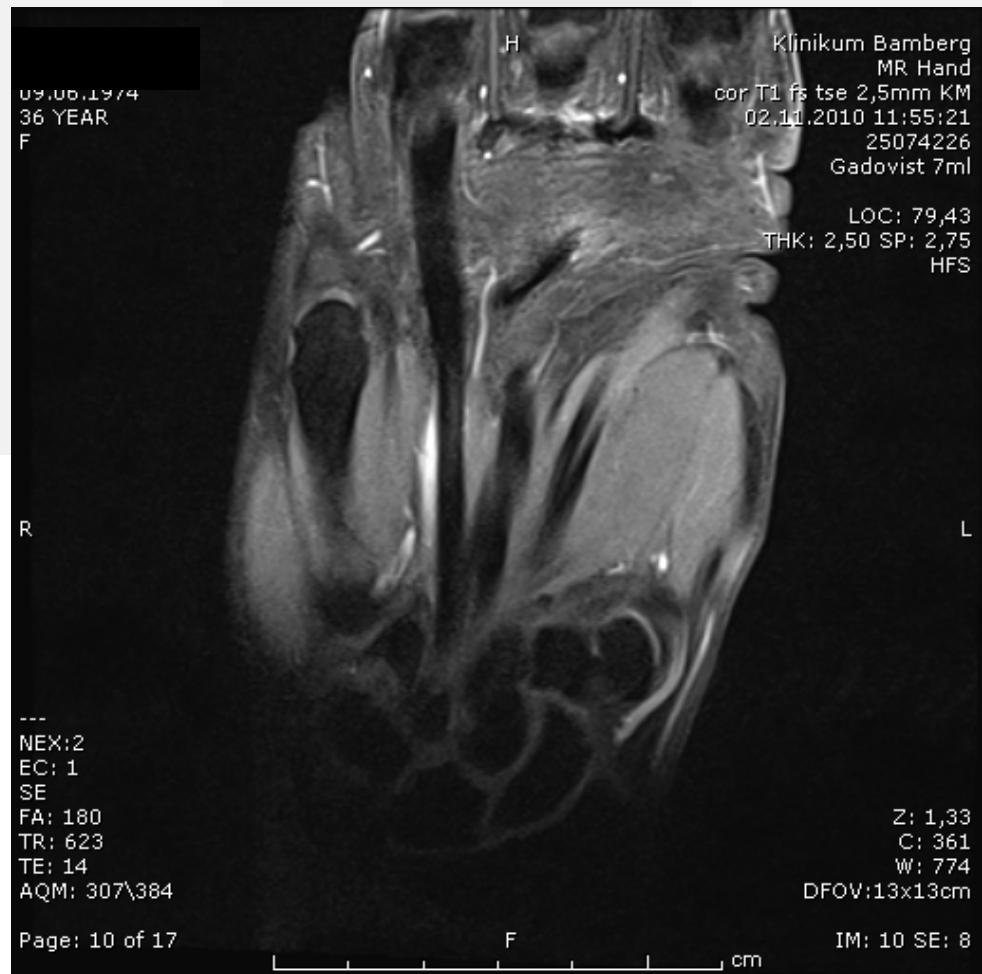
- Cons Tx
- Externals
- NSAIDs
- Sulphur
- Injections
- RSO (Erbium 169)
- Ammoniumbituminosulfonat (20%) (ICHTHOLAN)



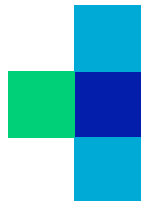
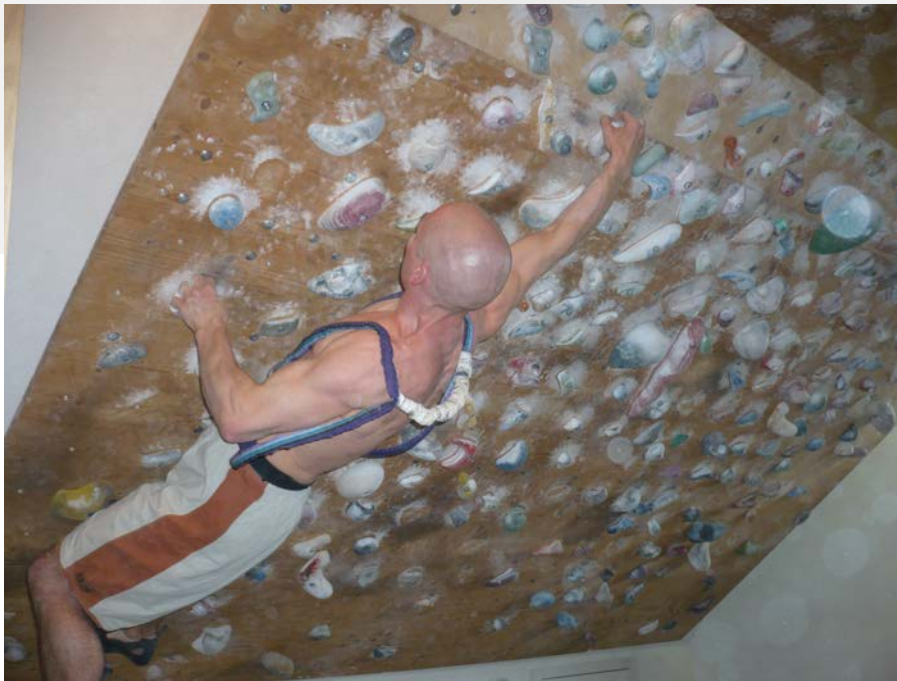
Lumbrical Shift Phenomenon



Lumbrical Tear



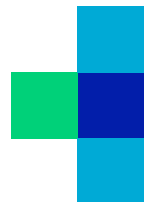
Tendon ruptures



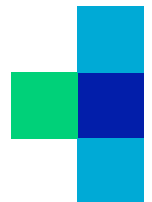
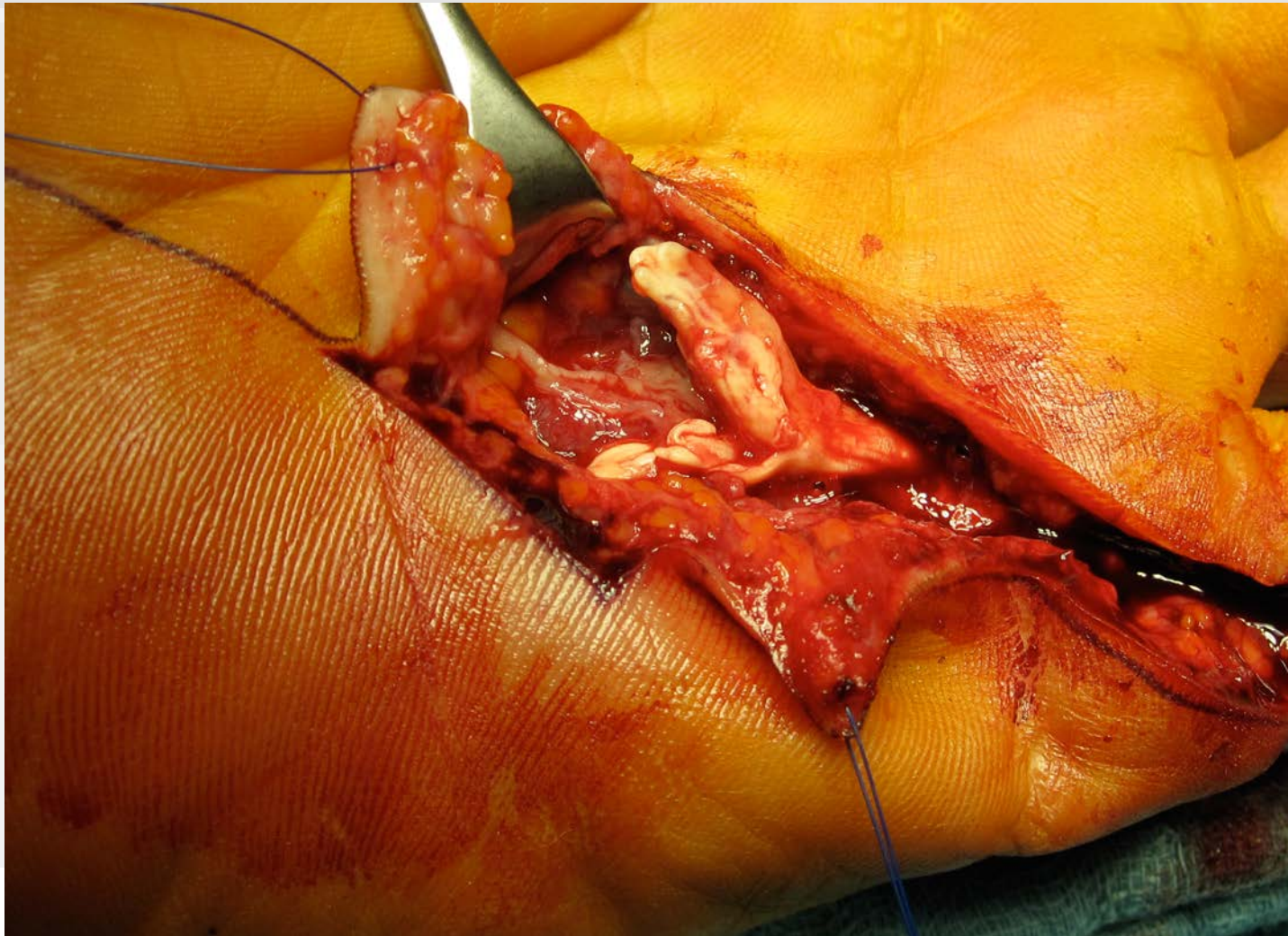
Tendon ruptures



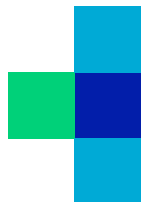
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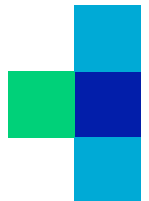
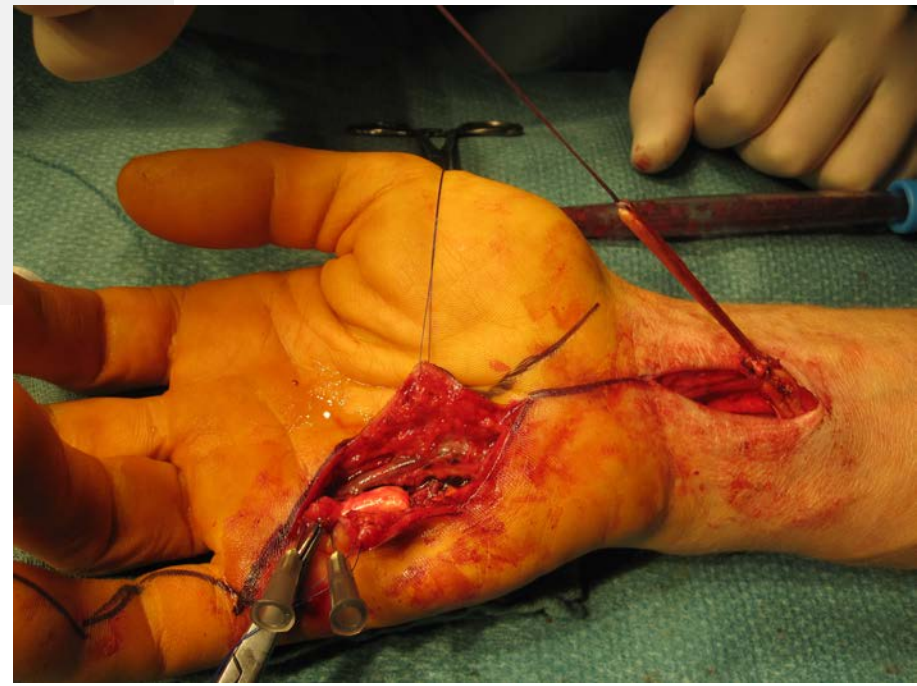
Tendon ruptures



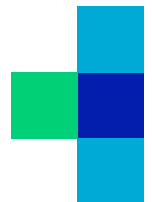
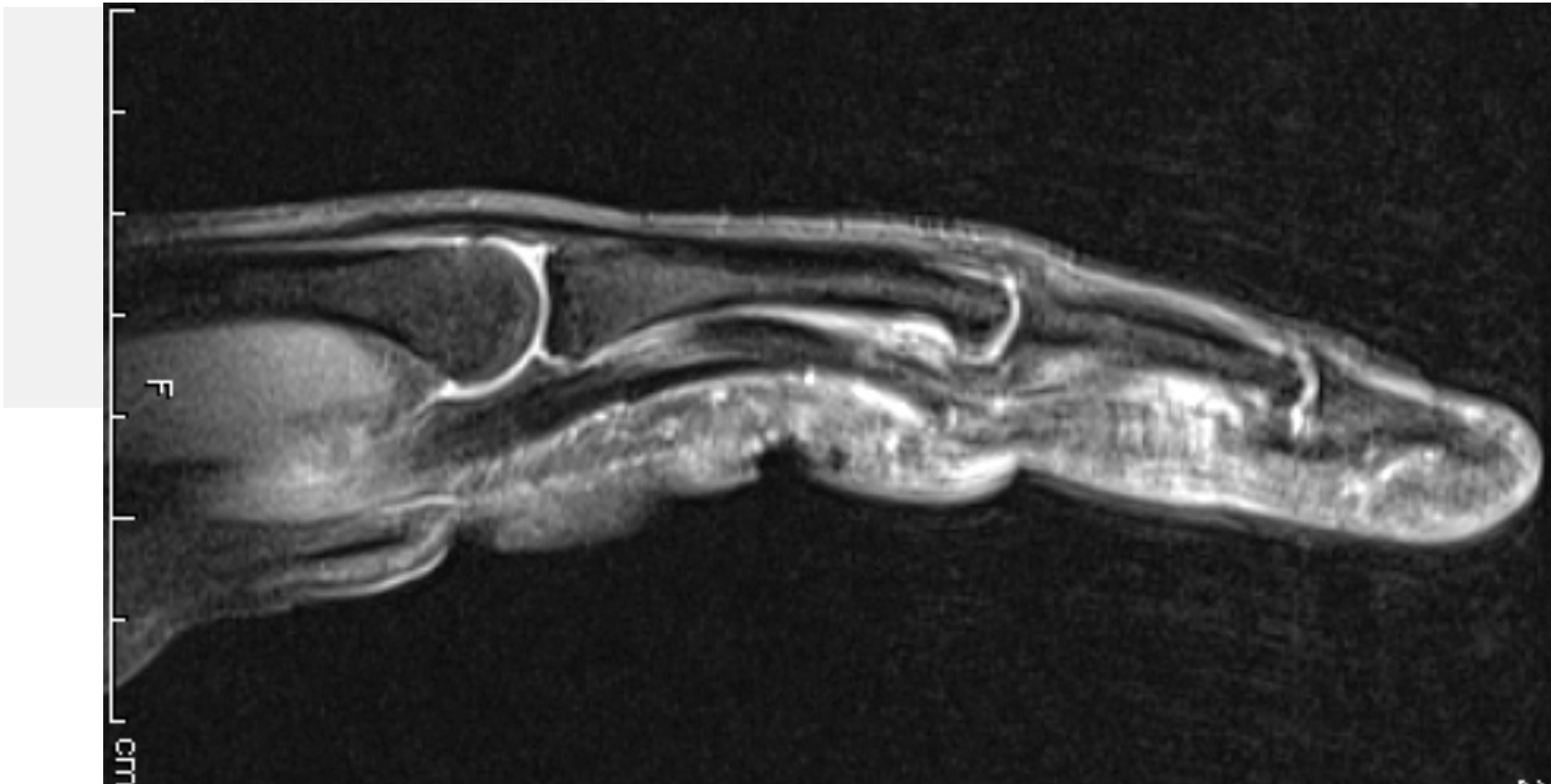
Tendon ruptures



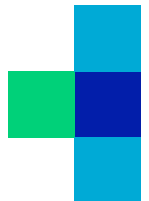
2 y later contralateral side



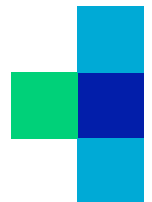
Tendon ruptures



Tendon ruptures



Extensor hood syndrome



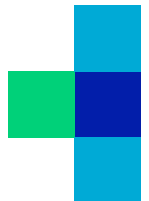
Extensor hood syndrome

Hans-Martin
2937
.1963
HR

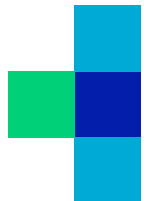
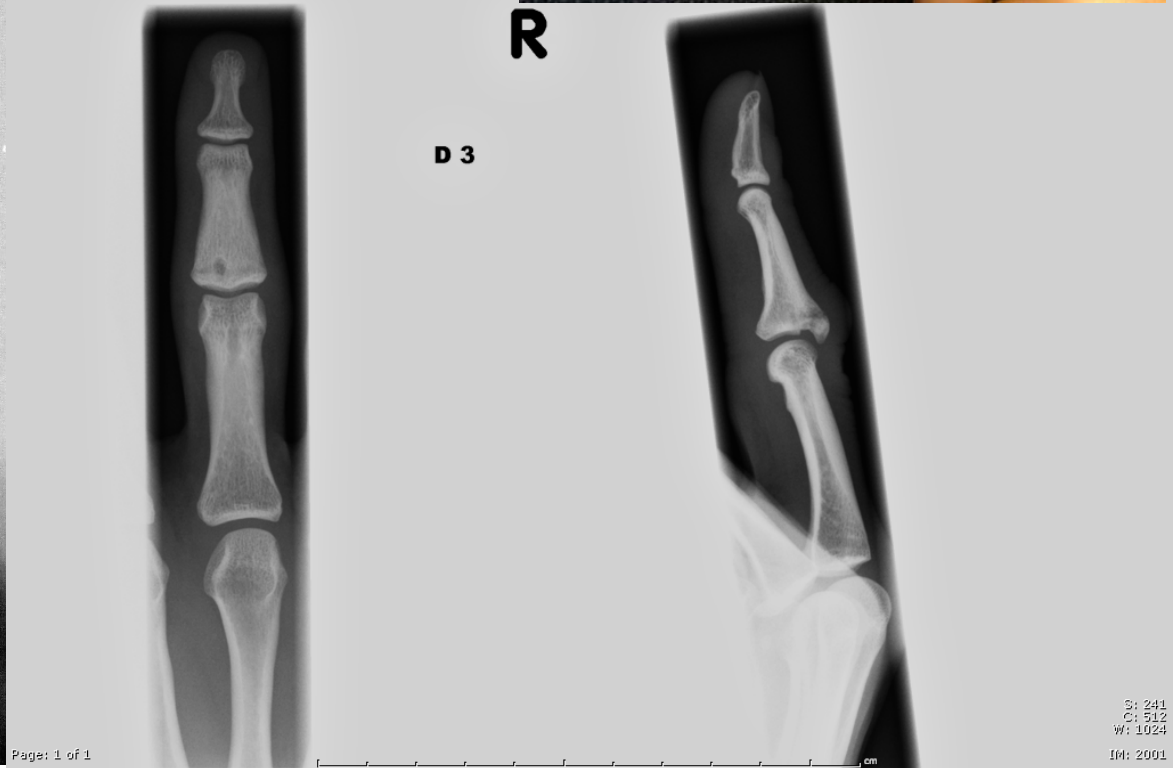
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Dr. Gehmacher / Dr. Hochholzer
CD einlesen
FINGER, SEITL.
20.10.2009 12:13:50
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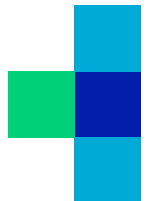
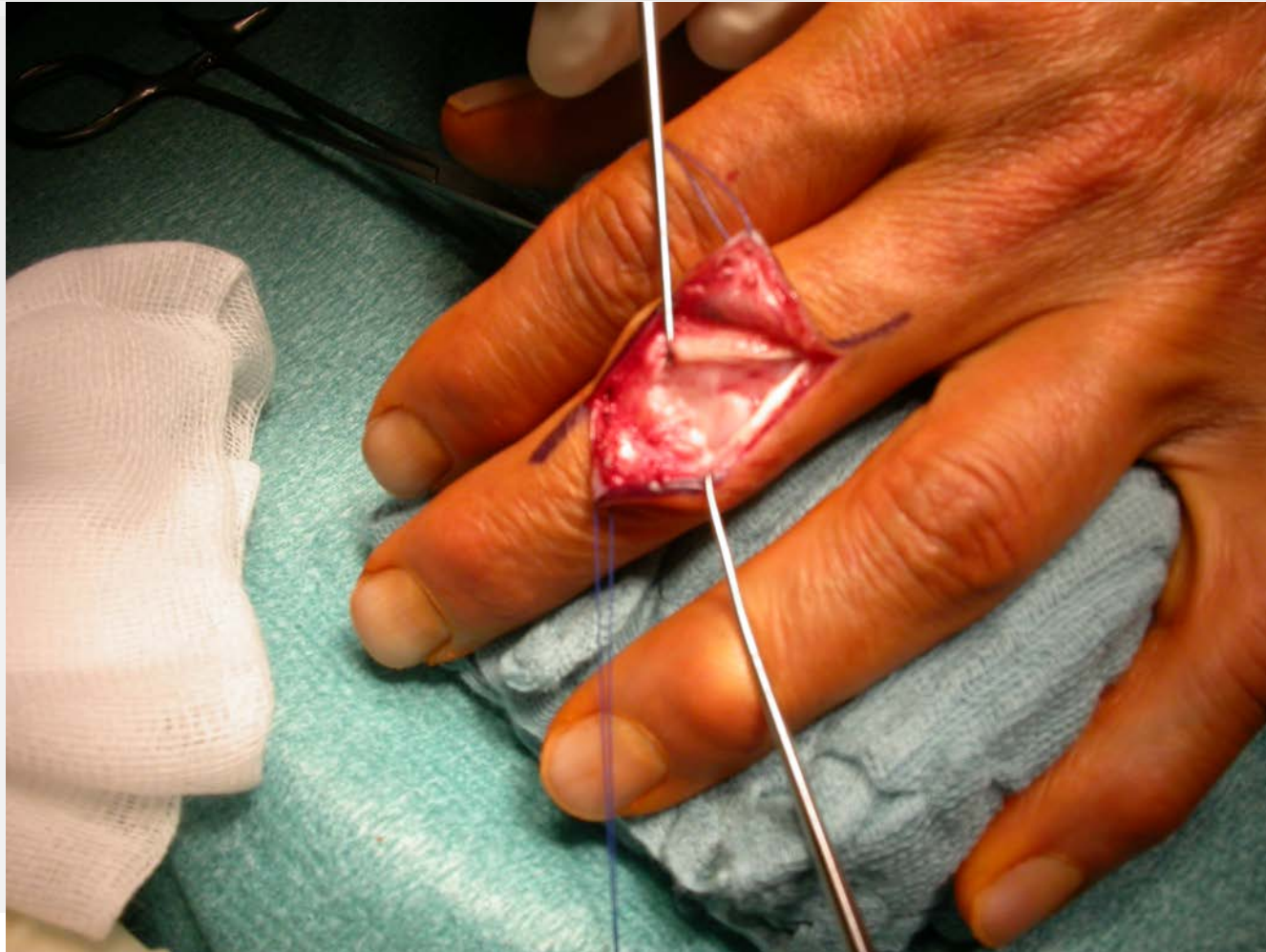
Extensor hood syndrome



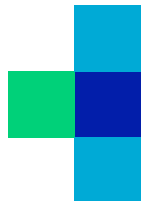
Extensor hood syndrome (K.L.)



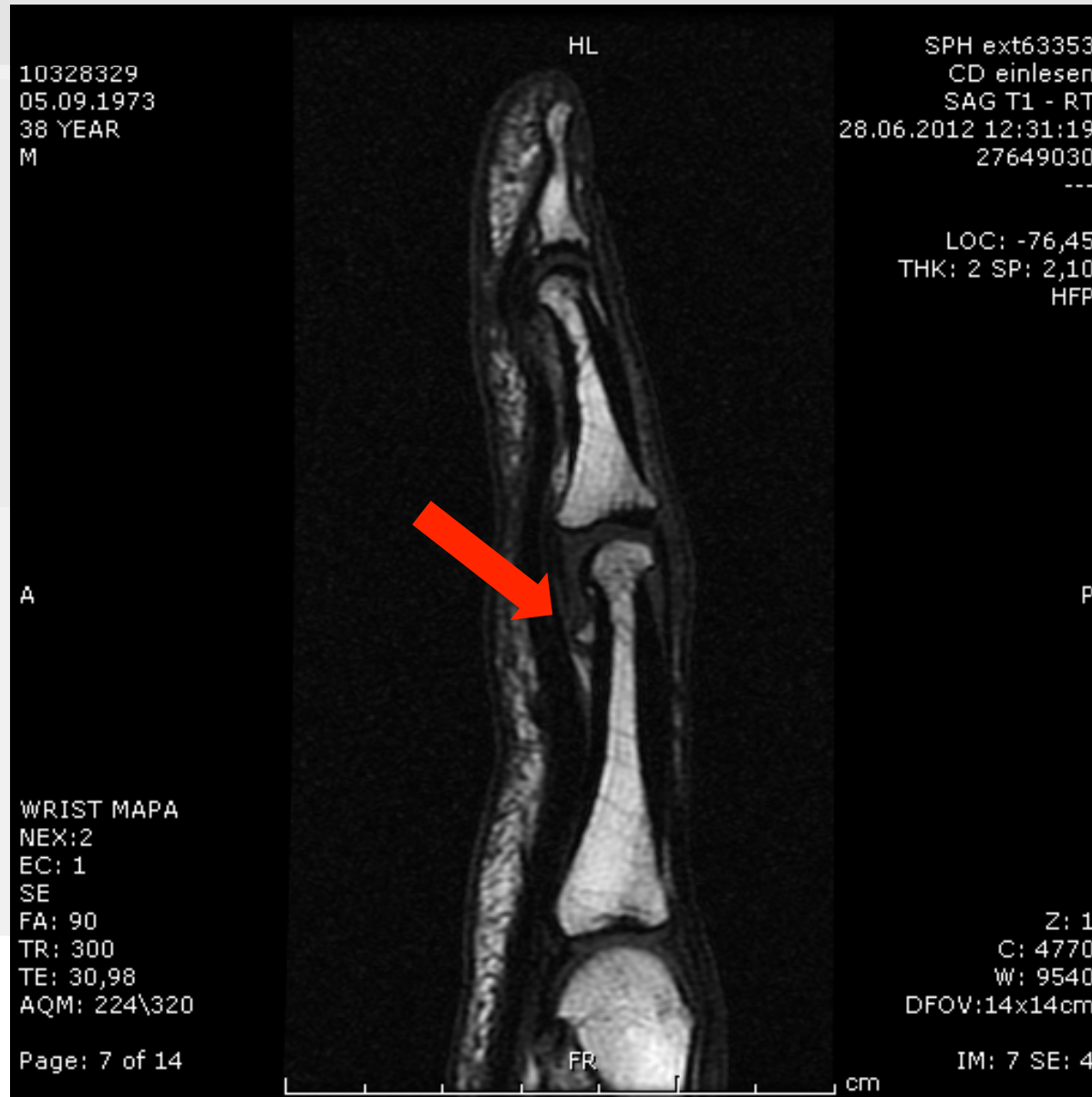
Extensor hood syndrome (K.L.)



Extensor hood syndrome (K.L.)



Bone Spurs (G.J.)

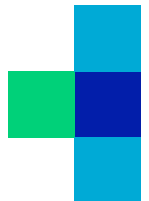


Infections!

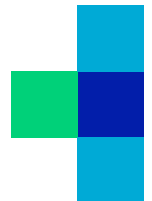
- Don't forget the normal pathologies !!!



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Finger and Hand Special: Rope Tangling Injury

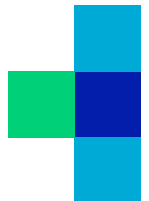




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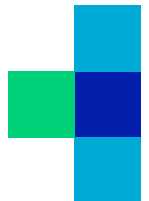
Finger and Hand Special: Rope Tangling Injury



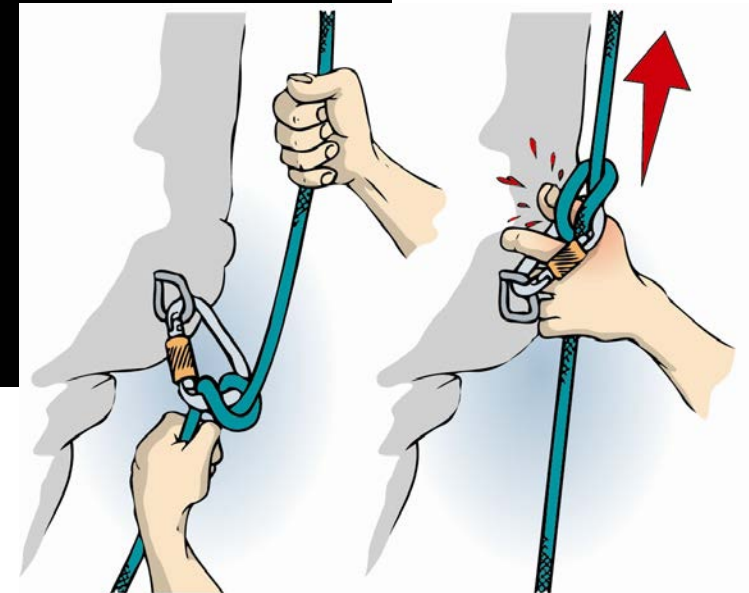
Finger and Hand Special: Rope Tangling Injury



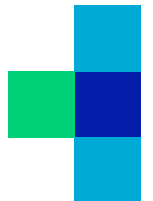
um



Finger and Hand Special: Rope Tangling Injury



Air Position !



Fingerring



Common Fingerinjuries

- Capsular Damage
- Collateral Ligament Injury
- Pulley Injury
- Tendovaginitis
- Fracture
- Epiphyseal Fractures
- Trigger Finger
- Dupuytren Contracture
- Osteoarthritis
- Ganglion
- Infection
- Lumbrical Shift Syndrome
- Amputation



and and and.....

