



SPORT
MEDISCH
NETWERK.NL

Sport gerelateerde letsels van de elleboog

Izaäk F. Kodde



ROA Nijmegen

27 okt 2017

TRAUMA AND SPORTS INJURIES OF THE ELBOW



Izaak F. Kodde



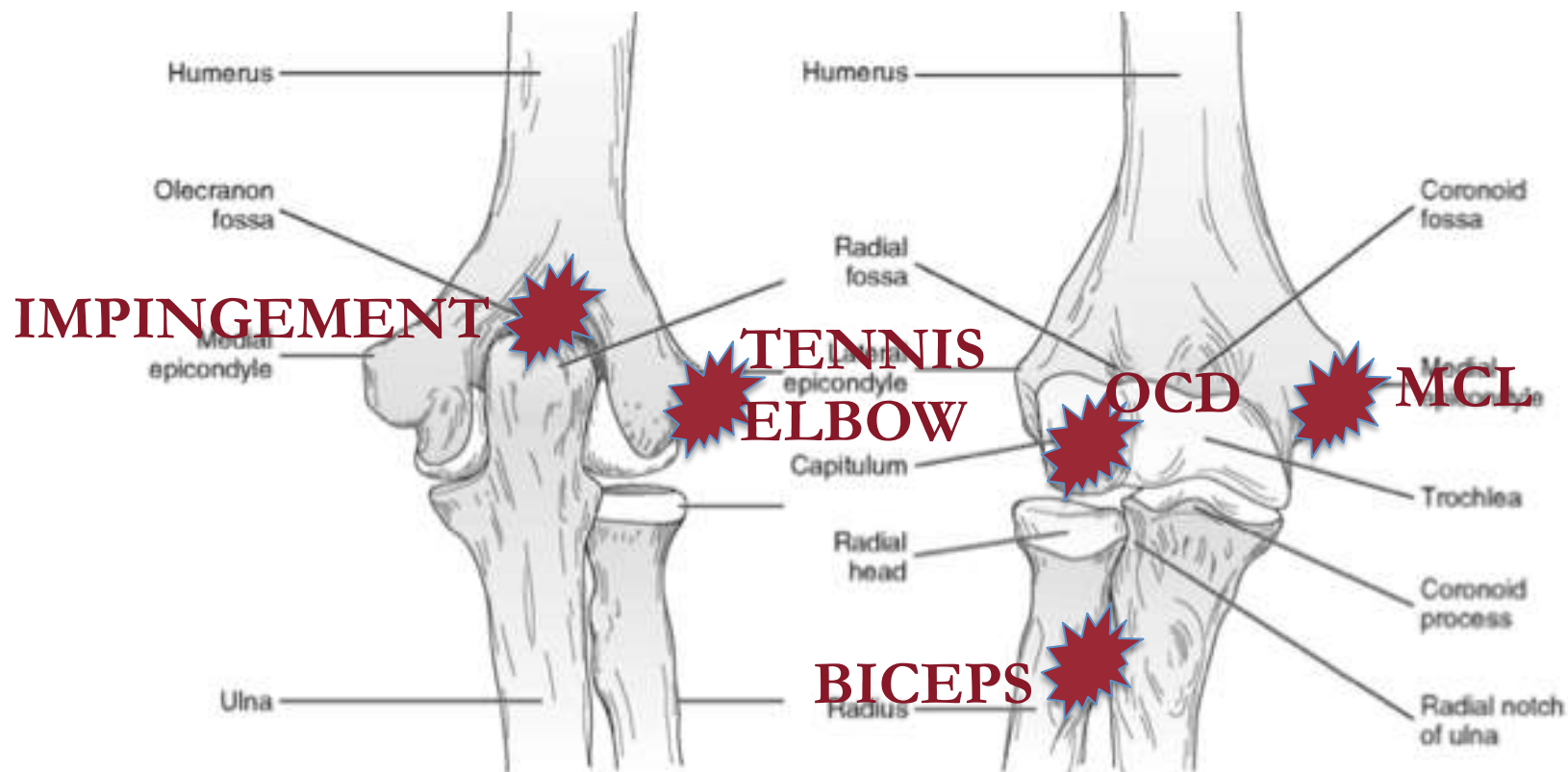
Sport blessures

4.5 million sports injuries/year in
the Netherlands

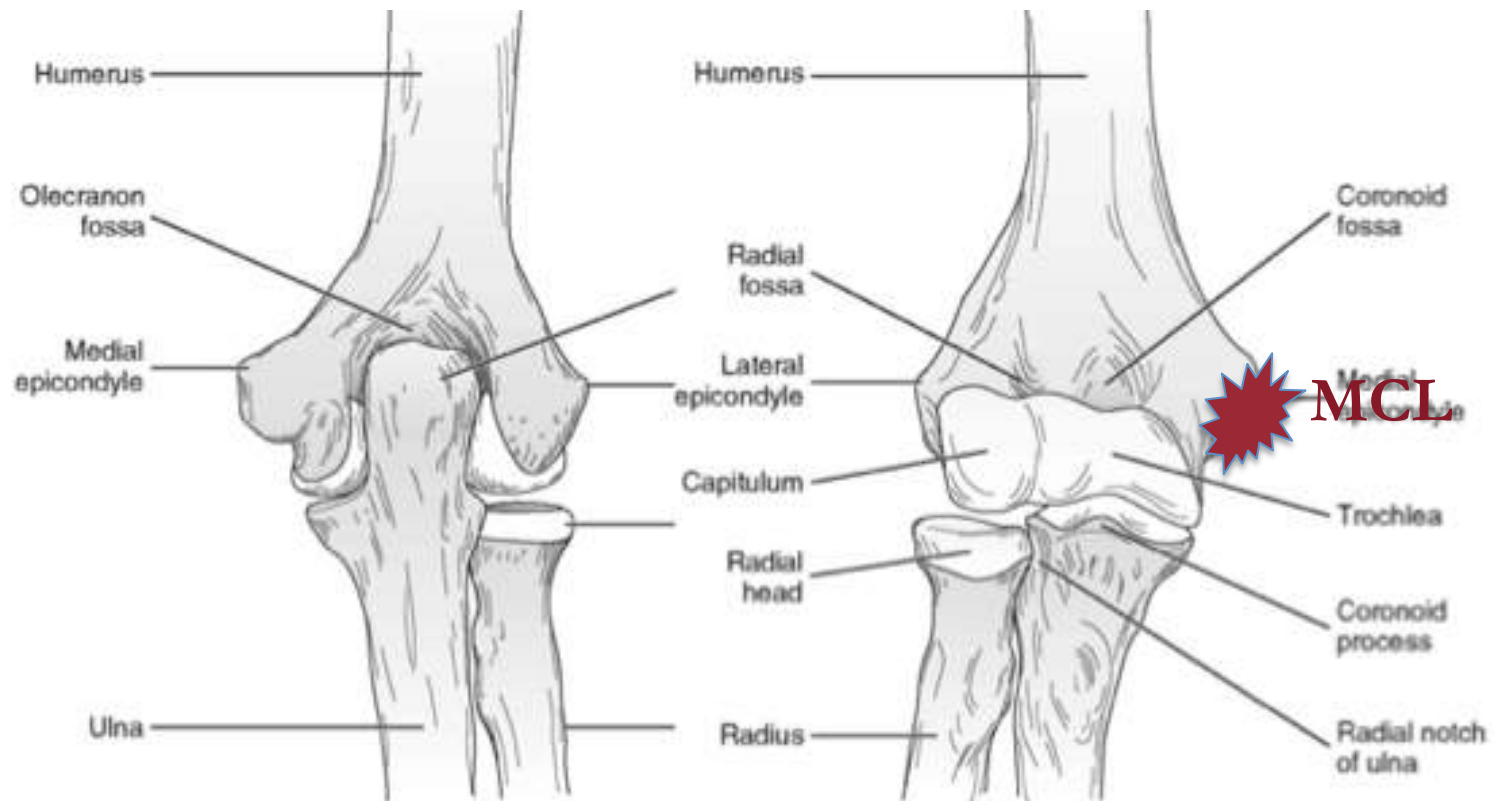
220.000 affect the elbow
5% of all injuries



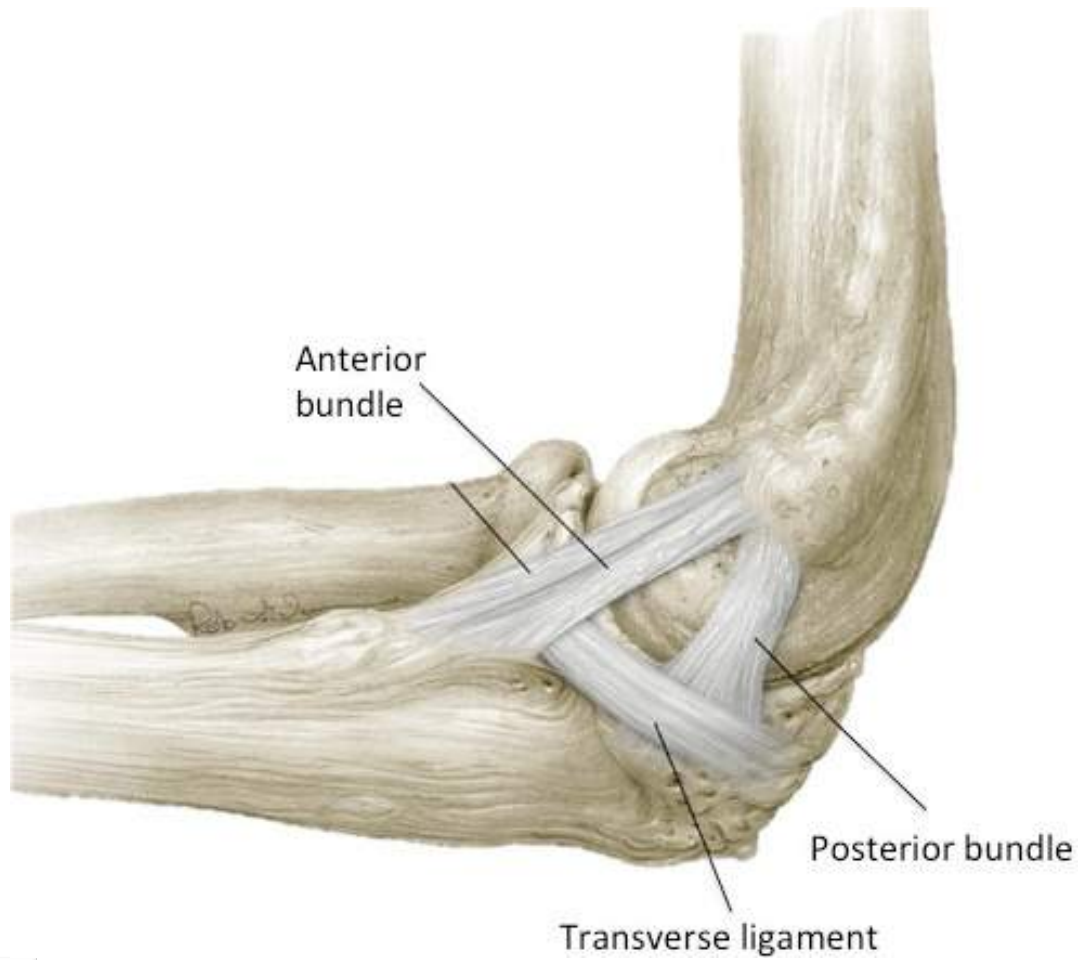
Blessures



Blessures



MCL - anatomie



MCL – valgus stabiliteit



Static	extension	90 deg flexion
MCL	31	54
Soft tissue/capsule	38	10
Articular/osseous	31	33

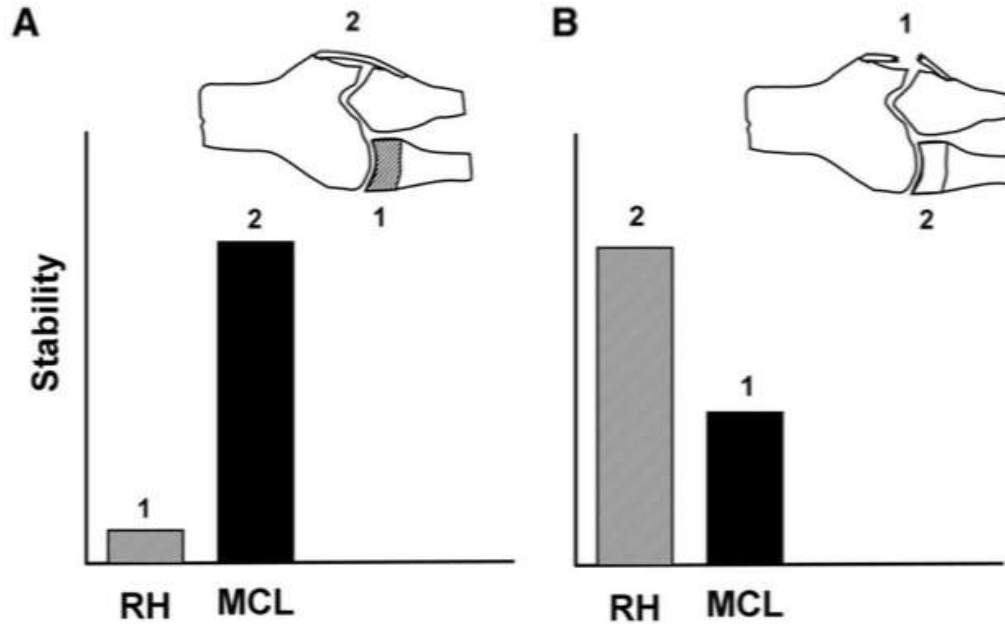
Relative contribution to valgus stress resistance (%)

- Flexor carpi ulnaris (FCU) primary dynamic stabilizer
- Flexor digitorum superficialis (FDS) = secondary stabilizer



Morrey 1983, Regan 1991, Olsen&Eyendaal 1998

MCL - stabiliteit



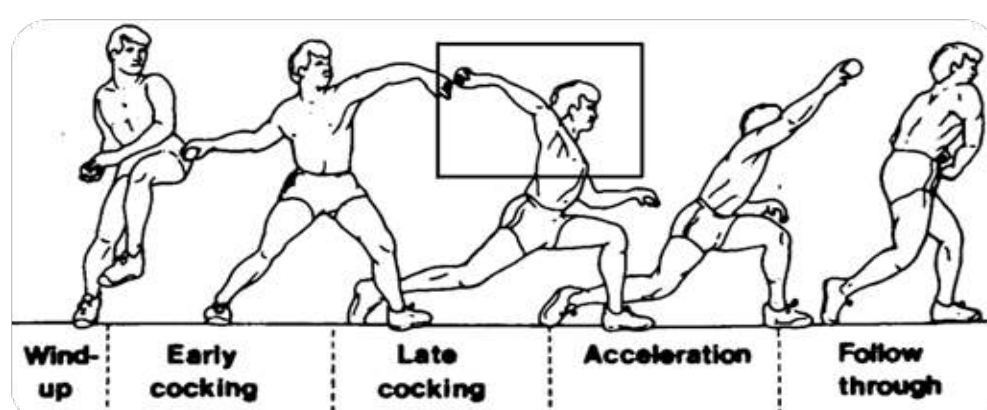
Primary valgus stabilizer



MCL - letsels



- MCL insufficiëntie door:
 - acuut valgus trauma (luxatie)
 - chronische overbelasting



Which Yankees have the highest risk of undergoing Tommy John surgery?

By Jake Devin [@JakePDevin](#) on Mar 5, 2016, 5:00p 12



Adam Hunger-USA TODAY Sports

The Tommy John epidemic has shown no signs of stopping. Which Yankee pitchers are most likely to be struck next?

TWEET

SHARE (15)

PIN

While the rate of players successfully returning from Tommy John surgery is higher than ever, so is the rate of players undergoing the surgery in the first place. A tear of the UCL (ulnar collateral ligament) still requires at least a year of rehabilitation and recovery, and remains as one of the most devastating



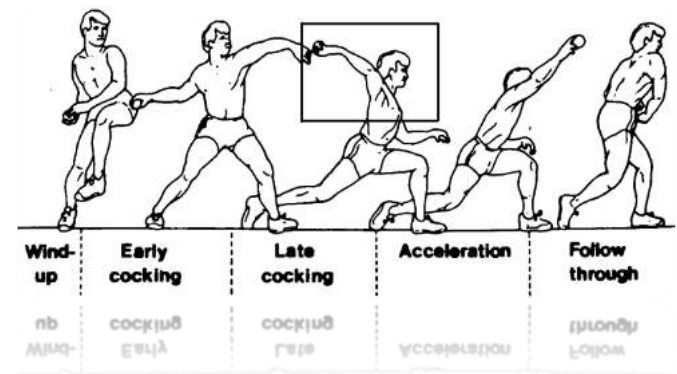
MCL – waarom atleten?



Angular velocity 2300 ° / sec

Valgus torque throwing 64 Nm,

Tennis serve 60 Nm



Tensile strength of native MCL; 33Nm

REVIEW

Biomechanics of the elbow joint in tennis players and relation to pathology

Denise Eygendaal, F T G Rahussen, R L Diercks

Br J Sports Med 2007;41:820-823. doi: 10.1136/bjsm.2007.038307

Elbow injuries constitute a sizeable percentage of tennis injuries. A basic understanding of biomechanics of tennis and analysis of the forces, loads and motions of the elbow during tennis will improve the understanding of the pathophysiology of these injuries. All different strokes in tennis have a different repetitive biomechanical nature that can result in tennis-related injuries. In this article, a biomechanically-based evaluation of tennis strokes is presented. This overview includes all tennis-related pathologies of the elbow joint, whereby the possible relation of biomechanics to pathology is analysed, followed by treatment recommendations.

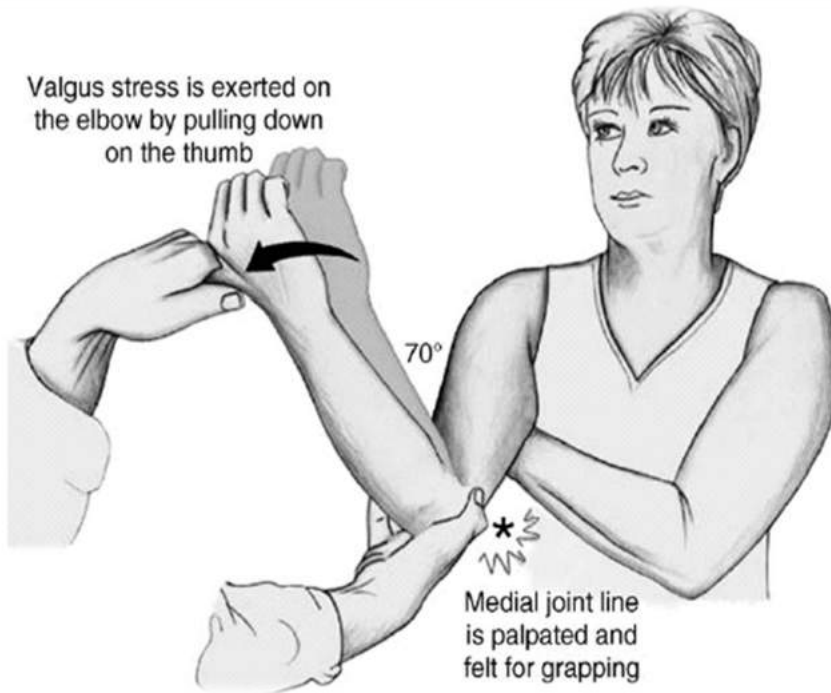
BIOMECHANICS OF THE ELBOW IN TENNIS
In the normal elbow joint, stability is maintained by the combination of joint congruity, capsuloligamentous integrity and well balanced intact muscles. The olecranon and olecranon fossa joint provide primary stability at less than 20° or more than 120° of elbow flexion. In between stability is provided by soft tissue constraints, mainly the UCL.^{1,2}

The kinetic chain of the tennis service starts with the feet and knees and travels through legs, trunk/back and shoulder to the elbow joint and finally through the wrist and hand. Biomechanically, the elbow functions primarily as a link in this kinetic chain, allowing transfer of kinetic energy from the body to the racquet.

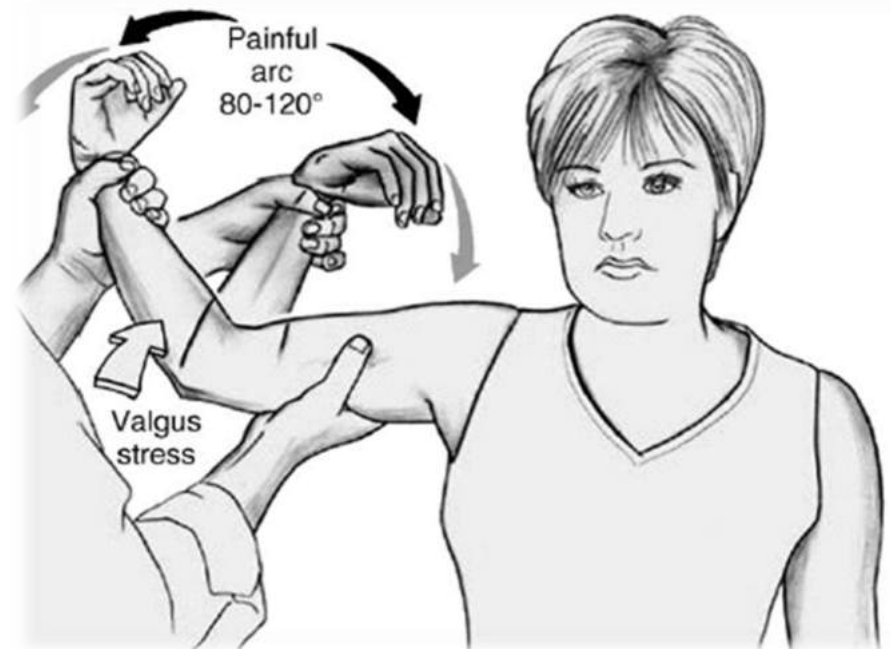
Onderzoek



Milking Manoeuvre



Moving Valgus Stress Test



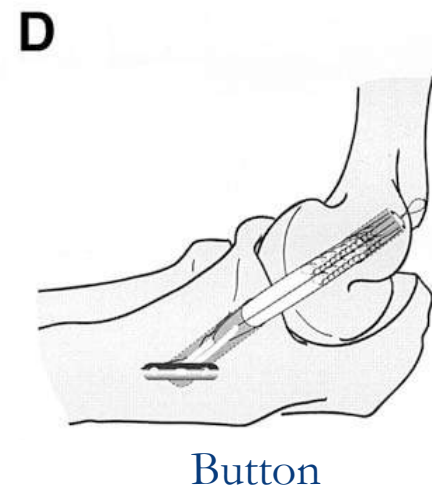
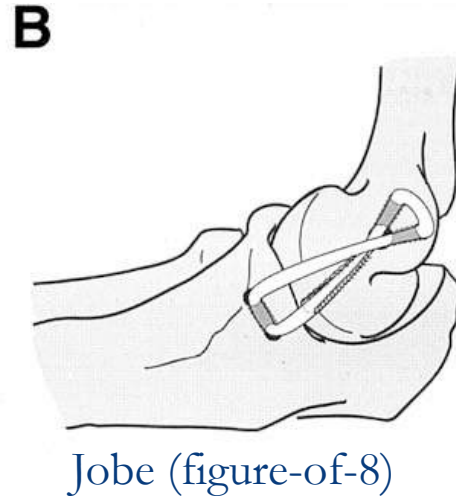
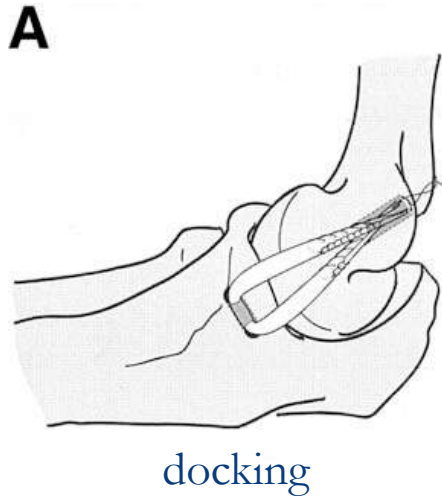
+ MRI



MCL – behandeling sporters



- Conservatief beleid succesvol in 42% (top)sporters.¹
- Operatief behandeling succesvol tot in 95% (top)sporters.²
- Vele operatietechnieken beschreven:



MCL - rehab

Current Concepts in Rehabilitation Following Ulnar Collateral Ligament Reconstruction

Todd S. Ellenbecker, DPT,*† Kevin E. Wilk, DPT,‡ David W. Altchek, MD,§ and James R. Andrews, MD¶

- Week 1: gips
- Wk 2-6: verkrijgen FROM
- Wk 6-12: opbouwen upper extremity kracht en endurance
- Wk 12-16: herstel volledige kracht, flexibiliteit en neuromusculaire controle
- M 4-9: return to activity and prevent reinjury.

Rehabilitation following surgical reconstruction of the UCL requires a gradual and protected return of ROM and an extensive resistive exercise program for the entire upper extremity program. Specific resistive exercise progressions aimed at providing dynamic stability to the scapulothoracic, glenohumeral, and ulnohumeral joints form an integral part of the comprehensive rehabilitation of the overhead athlete following reconstruction of the UCL.



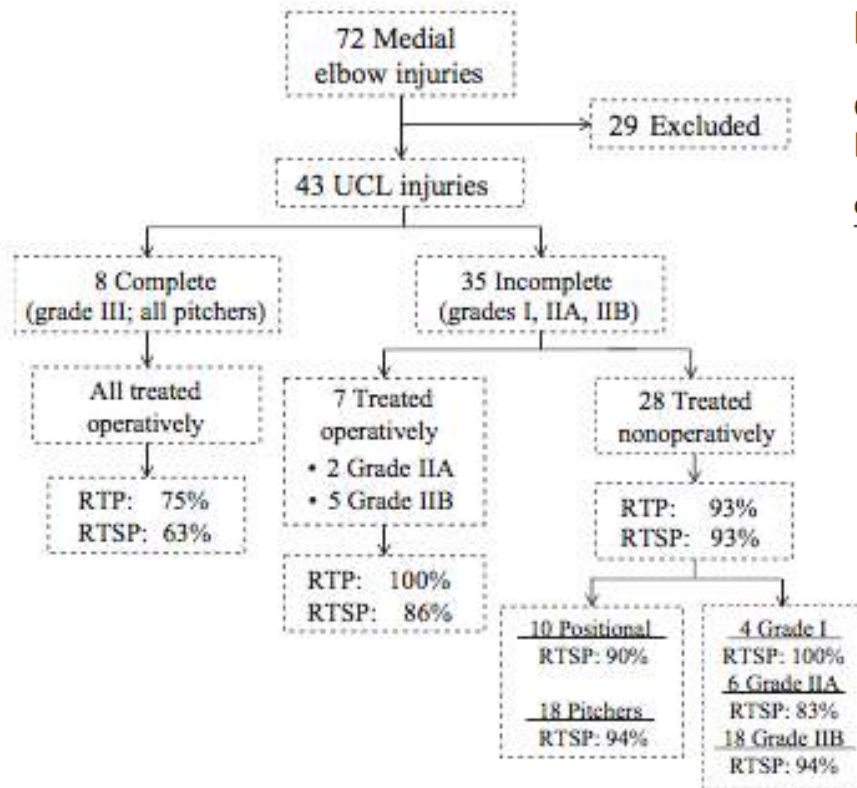
MCL - return to sports



Return-to-Play Outcomes in Professional Baseball Players After Medial Ulnar Collateral Ligament Injuries

Comparison of Operative Versus Nonoperative Treatment Based on Magnetic Resonance Imaging Findings

Gregory M. Ford,^{*,†} MD, MS, James Genuario,[†] MD, MS, Jason Kinkartz,[†] MD, Thomas Githens,[‡] DO, and Thomas Noonan,[†] MD



Rates of Return to Same Level of Play or Higher by MRI Grade, Regardless of Treatment

MRI Grade	Rate, %
I	100
IIA	88
IIB	91
III	63

Figure 1. Study flowchart. MRI grading scale: I = intact ligament with or without edema, IIA = partial tear, IIB = chronic healed injury, III = complete tear. RTP, return to play; RTSP, return to same level of play or higher; UCL, ulnar collateral ligament.

MCL - Preventie



- proper throwing/tennis mechanics
- proper flexor/pronator strengths
- proper shoulder mobility (GIRD)



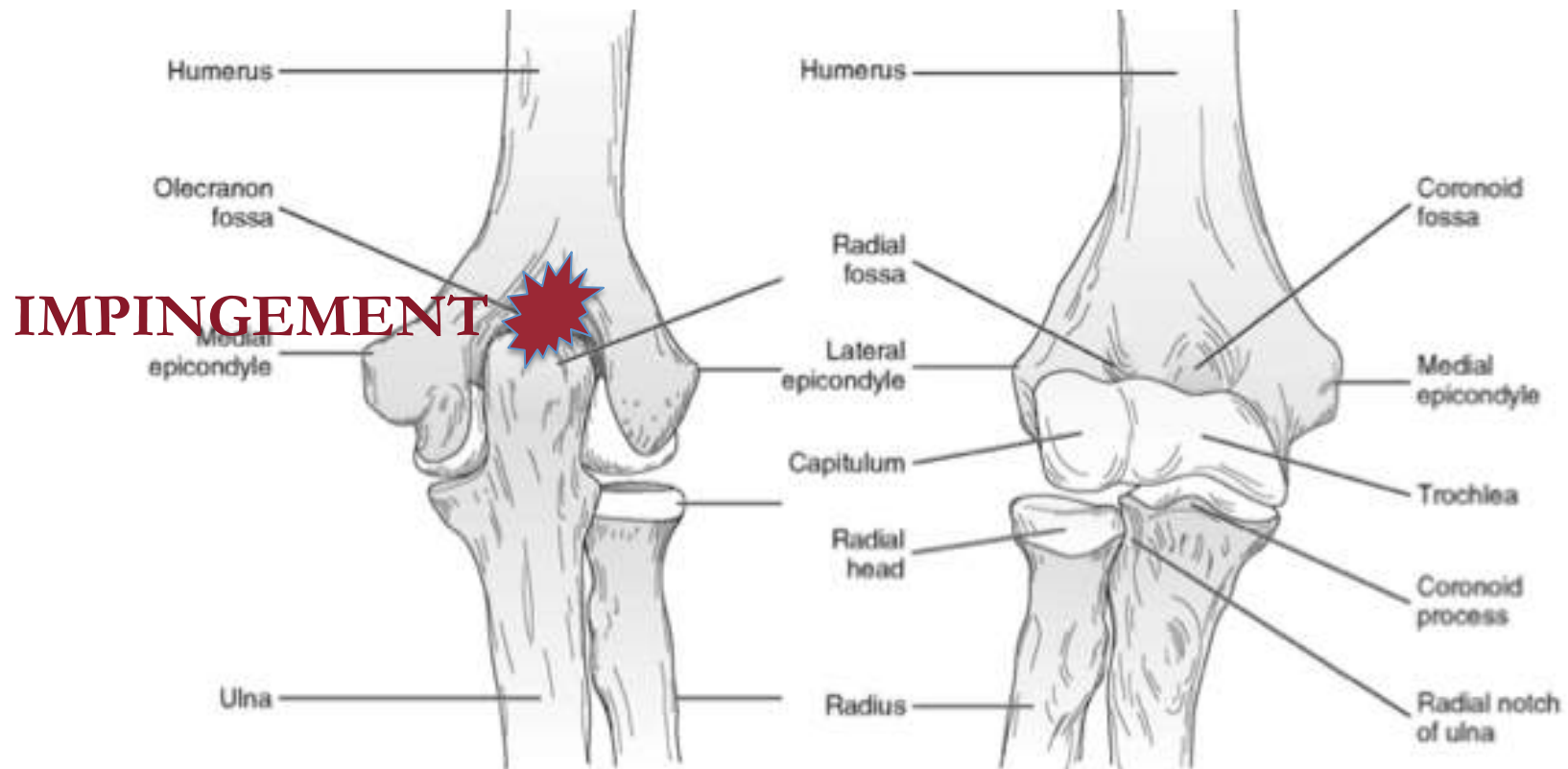
MCL - conclusie



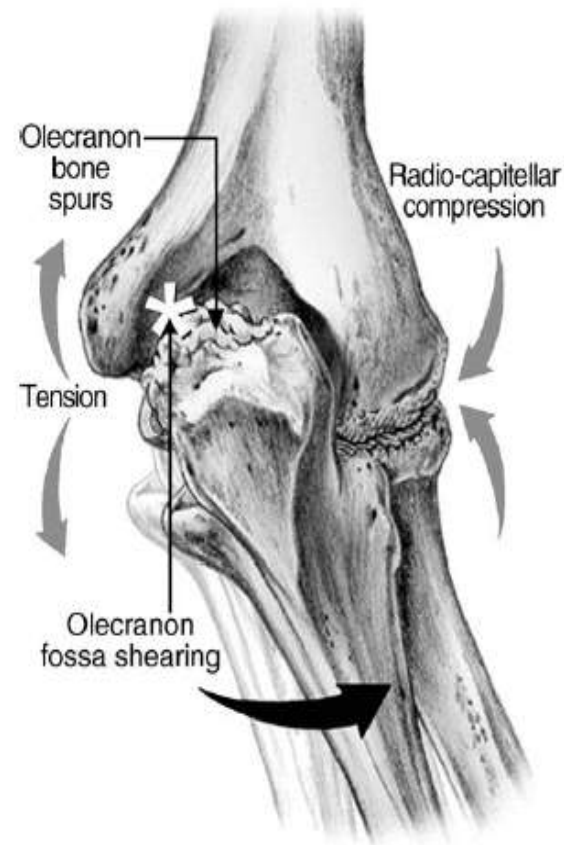
- Operatief bij volledige rupturen en topsporters.
- $\neq$ sporter en $\neq$ volledige ruptuur $\rightarrow$ conservatief proberen.
- MRI speelt een rol in indicatiestelling
- Dynamische stabiliteit door flexor-pronator groep.



Blessures



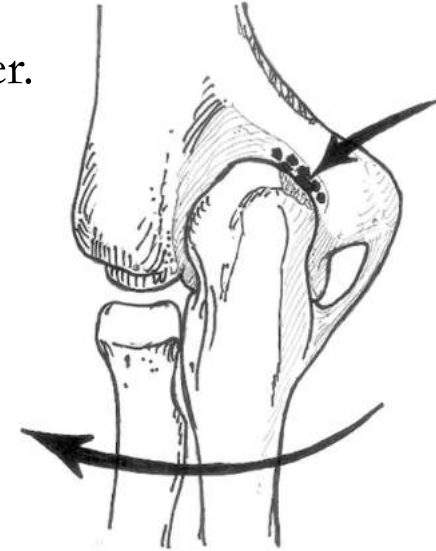
VEOLS



Impingement - basics



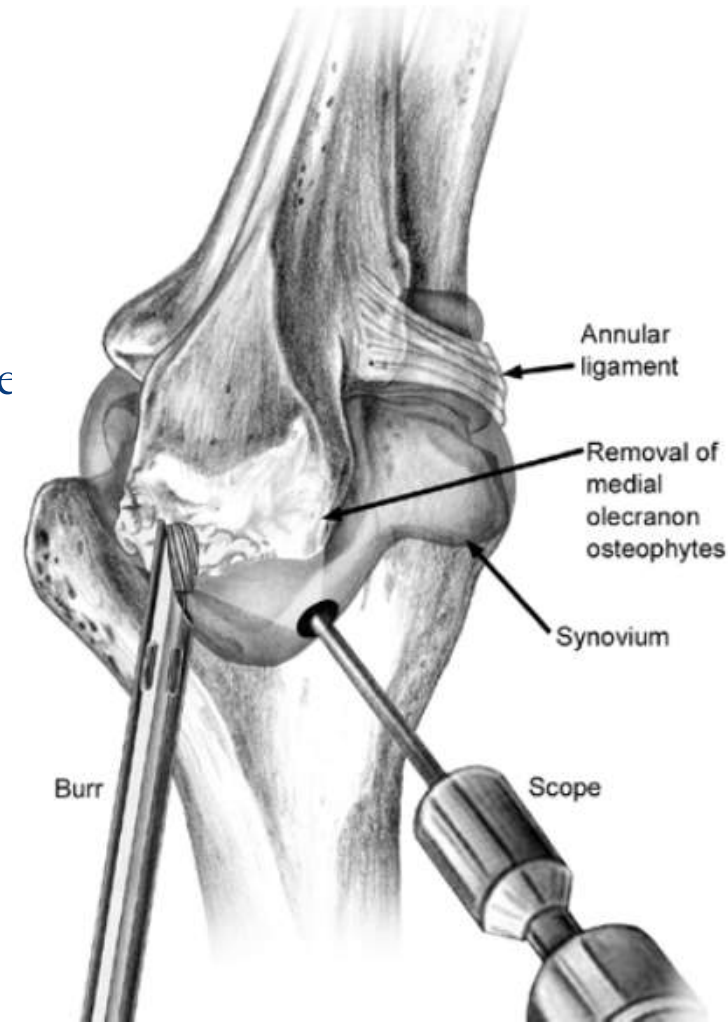
- Posteromediaal impingement vooral in de bovenhandse sporter.
- 10% van Japanse high-school baseballers
- Onderdeel van VEOALS
- Formatie van bot of weke delen in post. compartiment
- -> axial X + CT +/- MRI
- Posterolateraal impingement in boxers.
 - Hyperextensie + pronatie.



Impingement - scopie



- Scopie is geïndiceerd bij falen van conservatief (fysio, RICE, injectie) beleid.
- Scopie:
 - 2-3 posterieure portals
 - Beoordelen stabiliteit
 - Debridement met shaver van bot / weke dele
 - Resectie loose bodies



Impingement - rehab

- Snel actief oefenen obv fysiotherapeut.
- Weinig evidence betreffende rehab protocollen
- 4 fases protocol
- Herstel naar sports 3-4 mdn

Phase one—acute phase

Goals

- Diminish pain and inflammation
- Normalize motion
- Retard muscular atrophy
- Reestablish dynamic stability (muscular balance)
- Control functional stress/strain

Exercises and modalities:

- Cryotherapy, ultrasound, electrical stimulation
- Flexibility and stretching for posterior shoulder muscles (improve internal rotation and horizontal adduction)
- Rotator cuff strengthening (especially external rotator muscles)
- Scapular muscles strengthening (especially retractor, protractor, depressor muscles)
- Dynamic stabilization exercises (rhythmic stabilization)
- Closed kinetic chain exercises
- Proprioception training
- Abstain from throwing

Phase two—intermediate phase

Goals

- Progress strengthening exercise
- Restore muscular balance (external/internal rotation)
- Enhance dynamic stability
- Control flexibility and stretches

Exercises and modalities

- Continue stretching and flexibility (especially internal rotation and horizontal adduction)
- Progress isotonic strengthening
 - Complete shoulder program
 - Thrower's Ten program
- Rhythmic stabilization drills
- Initiate core strengthening program
- Initiate leg program

Phase three—advanced strengthening phase

Goals

- Aggressive strengthening
- Progress neuromuscular control
- Improve strength, power, and endurance
- Initiate light throwing activities

Exercises and modalities

- Flexibility and stretching
- Rhythmic stabilization drills
- Thrower's Ten program
- Initiate plyometric program
- Initiate endurance drills
- Initiate short-distance throwing program

Phase four—return-to-activity phase

Goals

- Progress to throwing program
- Return to competitive throwing
- Continue strengthening and flexibility drills

Exercises

- Stretching and flexibility drills
- Thrower's Ten program
- Plyometric program
- Progress interval throwing program to competitive throwing



Impingement – return to sports



J Shoulder Elbow Surg (2009) 18, 279-282



Arthroscopic treatment of posterior impingement of the elbow in athletes: A medium-term follow-up in sixteen cases

Frank Th. G. Rahusen, MD^{a,*}, Justus-Martijn Brinkman, MD^b, Denise Eygendaal, MD, PhD^c

- 14/16 = 88% RTSP
- 3 mdn

Posterolateral Elbow Impingement in Professional Boxers

Kars P. Valkering,^{*,†} MD, Henk van der Hoeven,[†] MD, and Bas C. M. Pijnenburg,[§] MD, PhD
From the [†]Department of Orthopaedic Surgery, Spaarne Hospital, Hoofddorp, the Netherlands, the [†]Department of Orthopaedic Surgery, St Antonius Hospital, Nieuwegein, the Netherlands, and the [§]Department of Orthopaedic Surgery, Diaconessen Hospital Utrecht, Utrecht, the Netherlands

5/5 = 100% RTSP



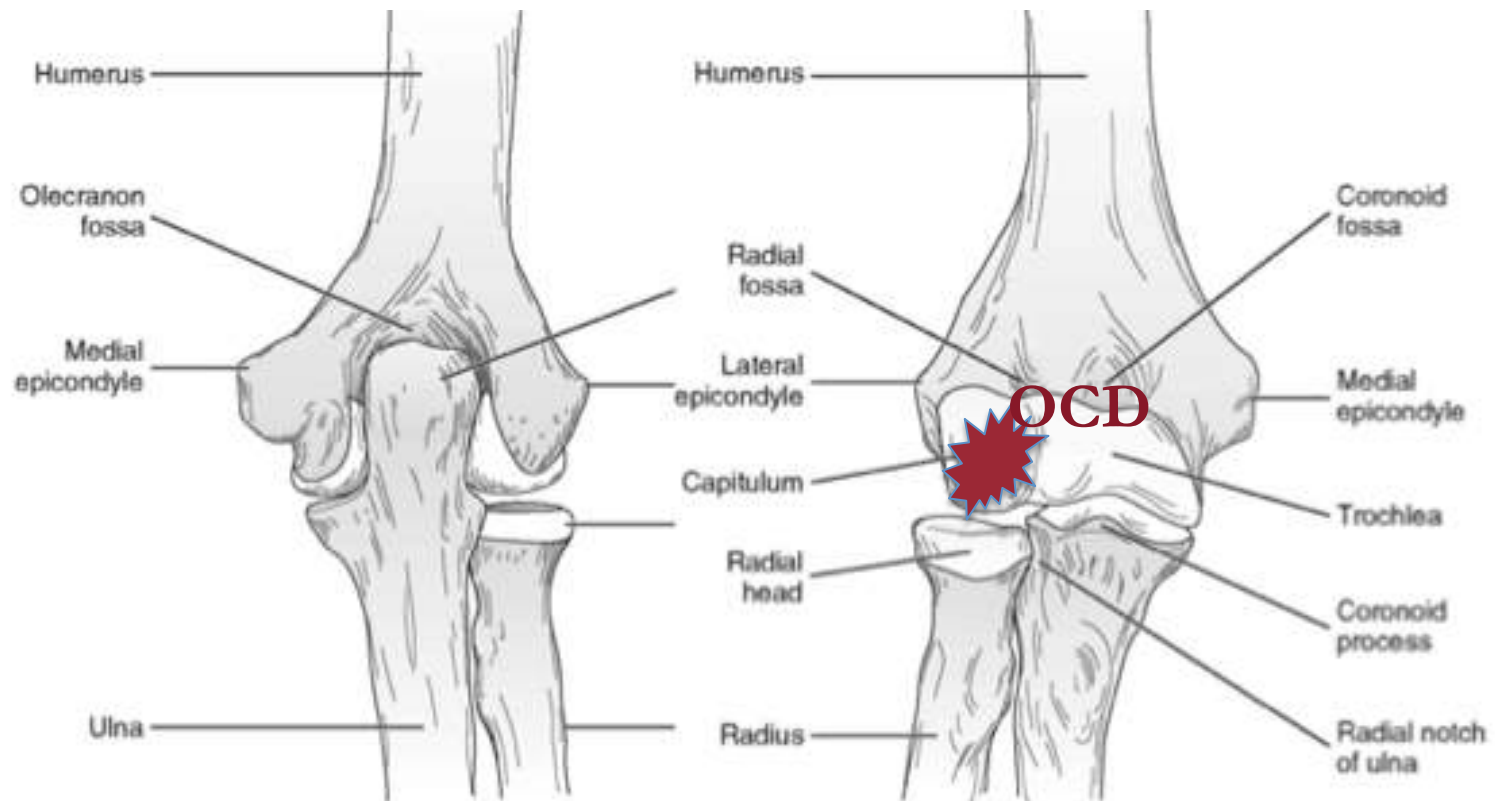
Impingement - conclusie



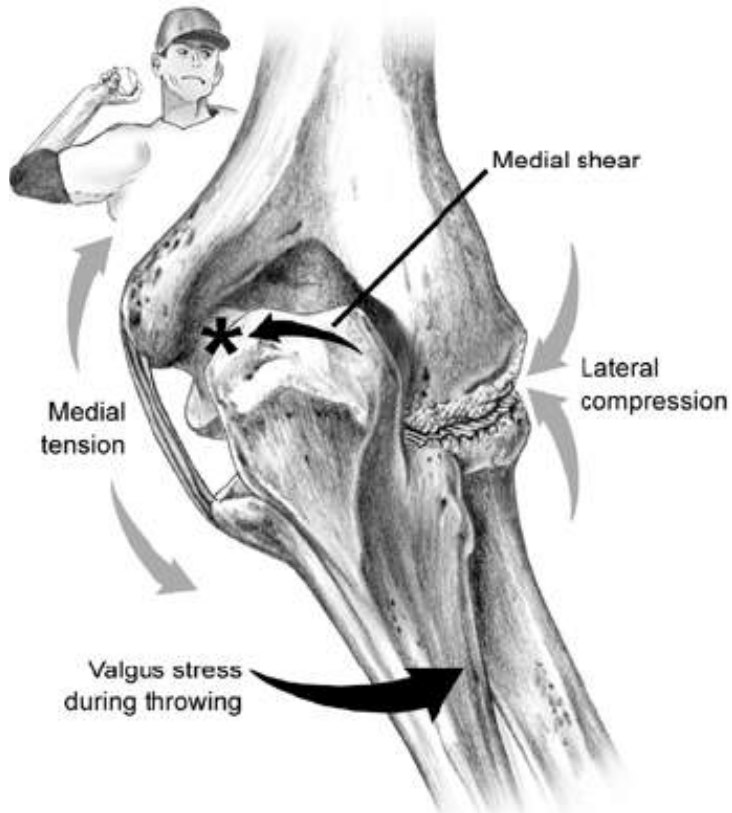
- Posteromediaal vs posterolateraal
- Scopische nettoyage goed resultaat
- RTSP 88-100%.
- Evidence summier



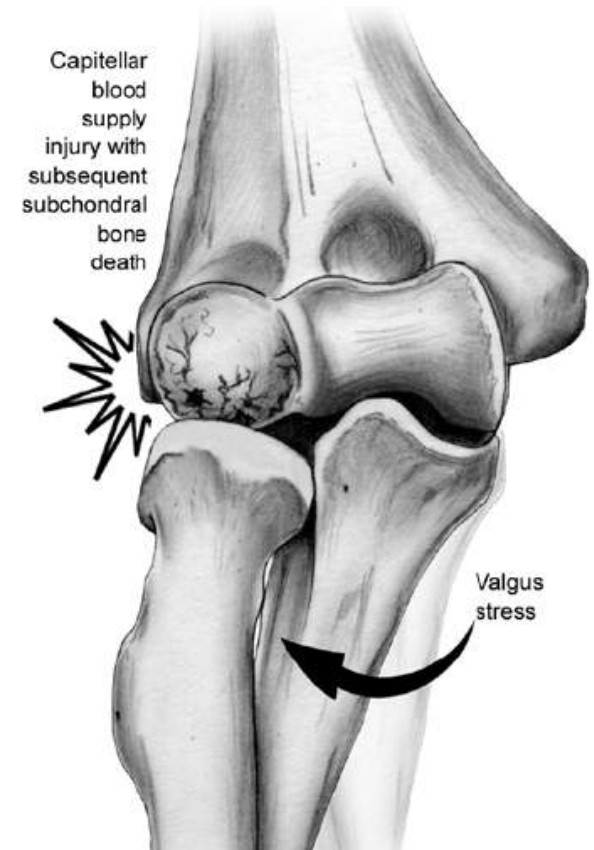
Blessures



OCD - basics



Werpers
11-16 jr
capitellum
Dominante arm



Osteochondritis dissecans



- Lateral elbow pain
 - Swollen elbow
 - RH pain/ crepitus
 - Light extension deficit
-
- X+MRI/CT
 - >11 y

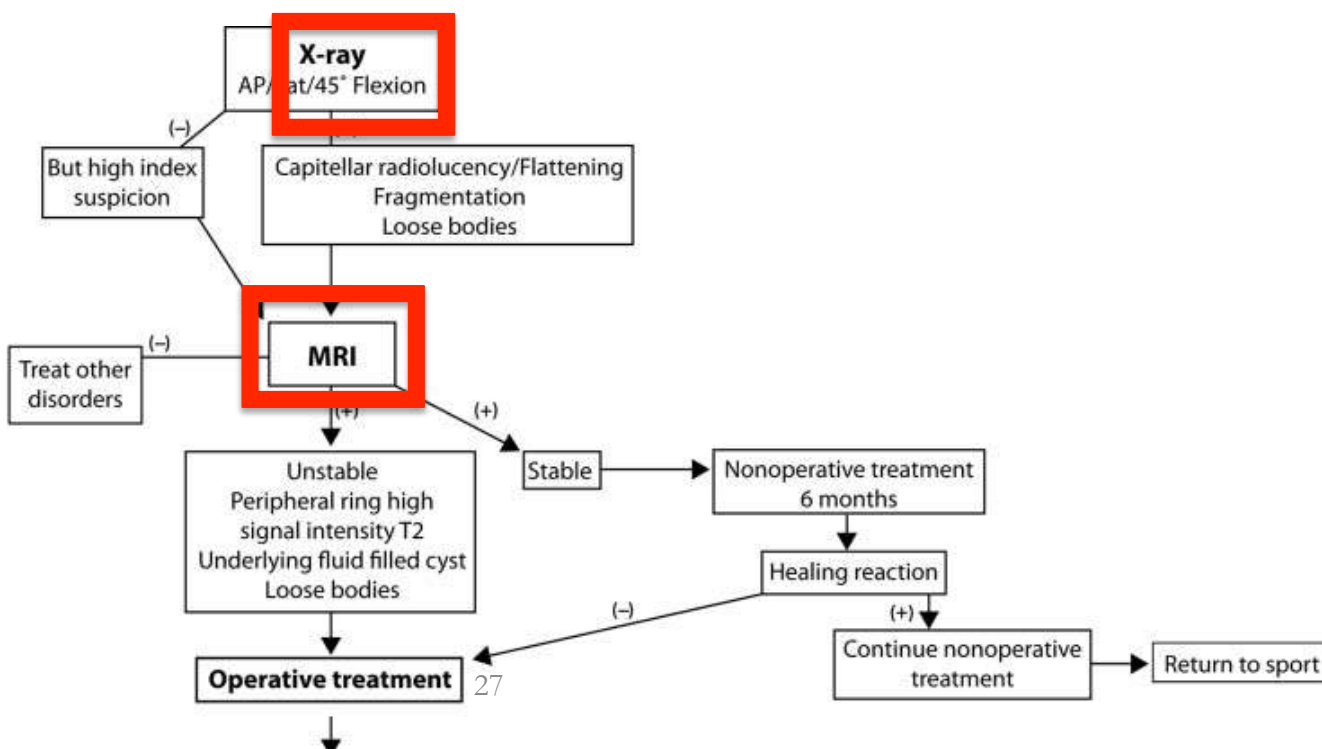


OCD - diagnose



TABLE I Classification and Treatment of Osteochondritis Dissecans Lesions

	Capitellar Growth Plate	Capitellar Lesion	Range of Motion	ICRS Classification
Stable	Open	Radiolucent	Normal	I: continuous
Unstable	Closed	Fragmentation	Restricted	II: partial discontinuity
				III: complete discontinuity
				IV: dislocated or loose

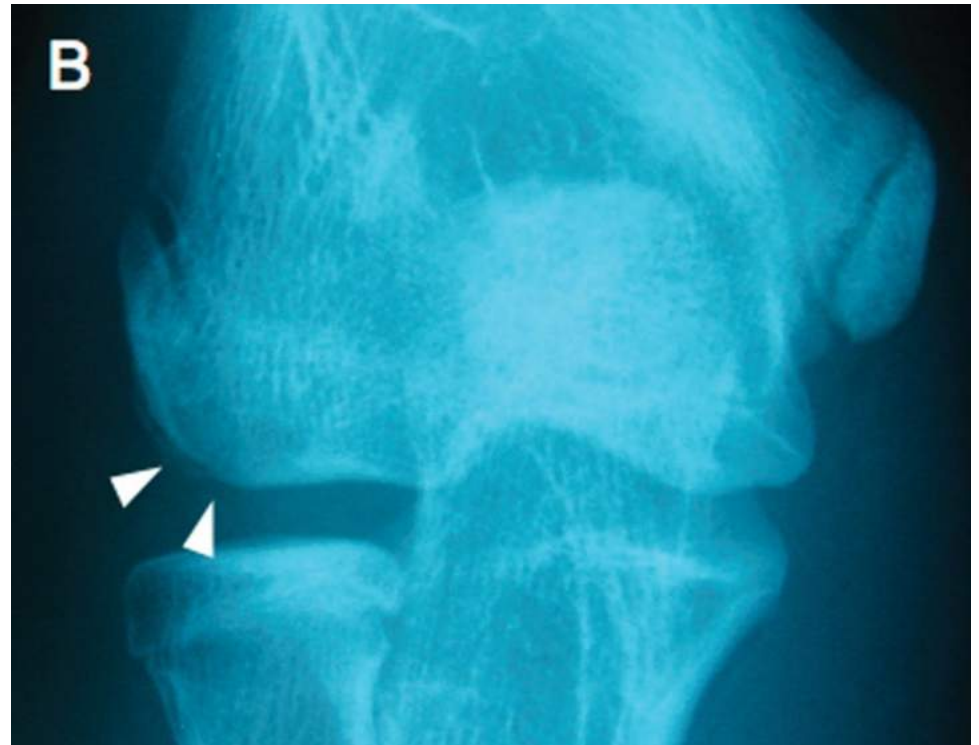


Ruchelsman et al - JAAO - 2010
Takahara et al - JBJS - 2008

OCD - Imaging



- Radiographs
 - extension



Takahara, JBJS-A, 2008

OCD - Imaging



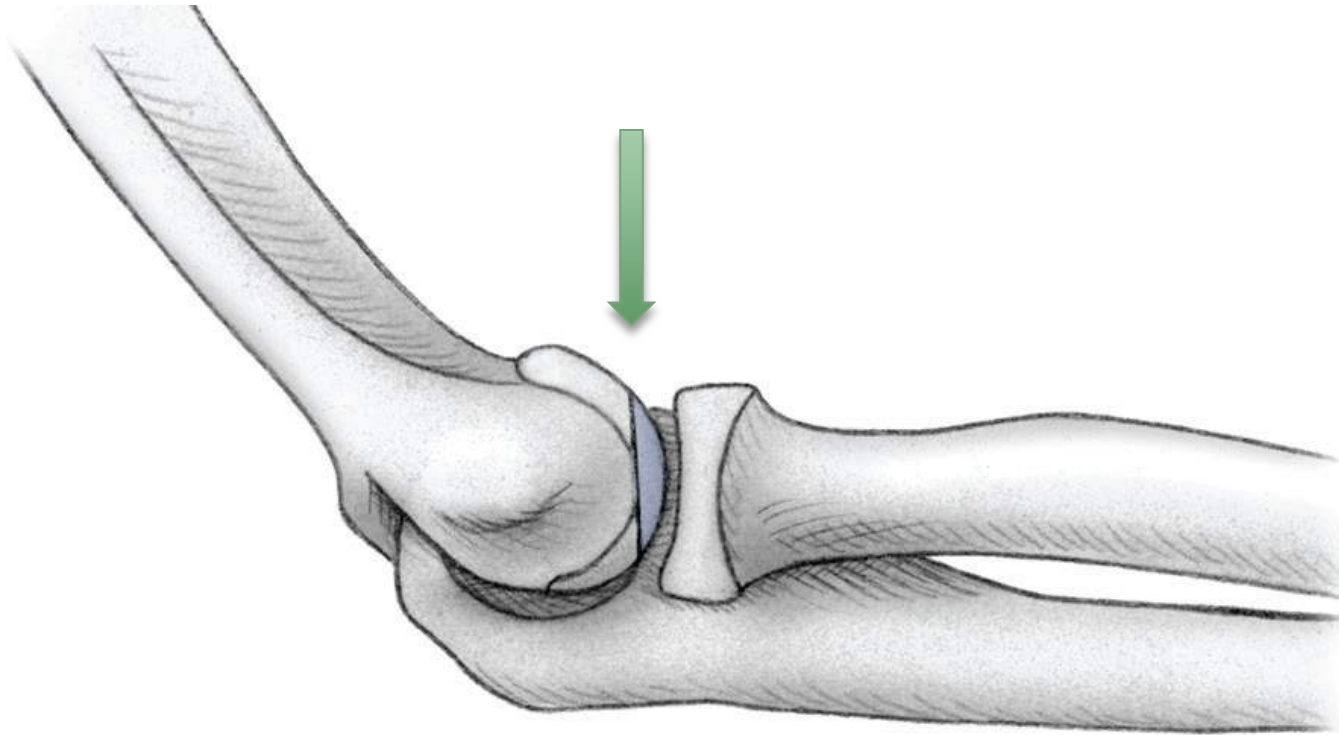
- Radiographs
 - 45° flexion



Takahara, JBJS-A, 2008

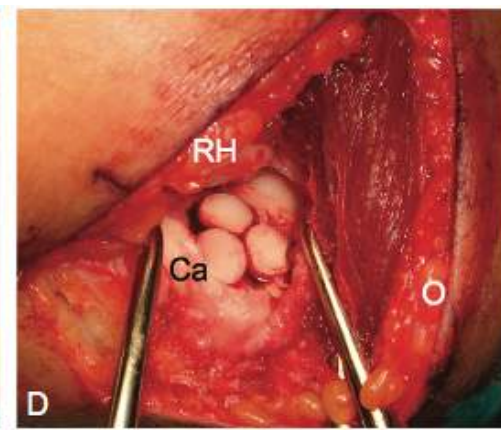
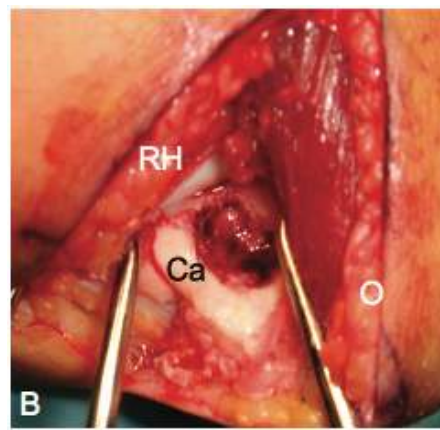
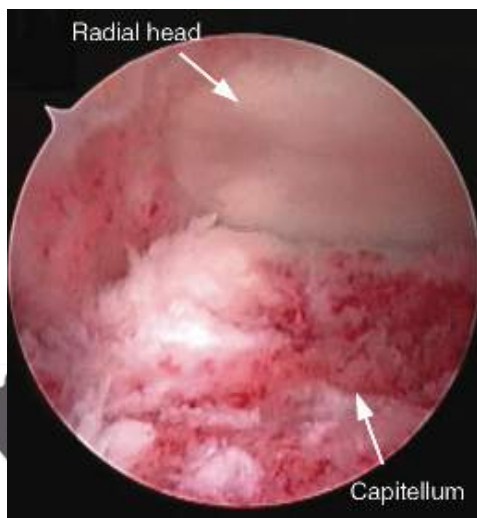
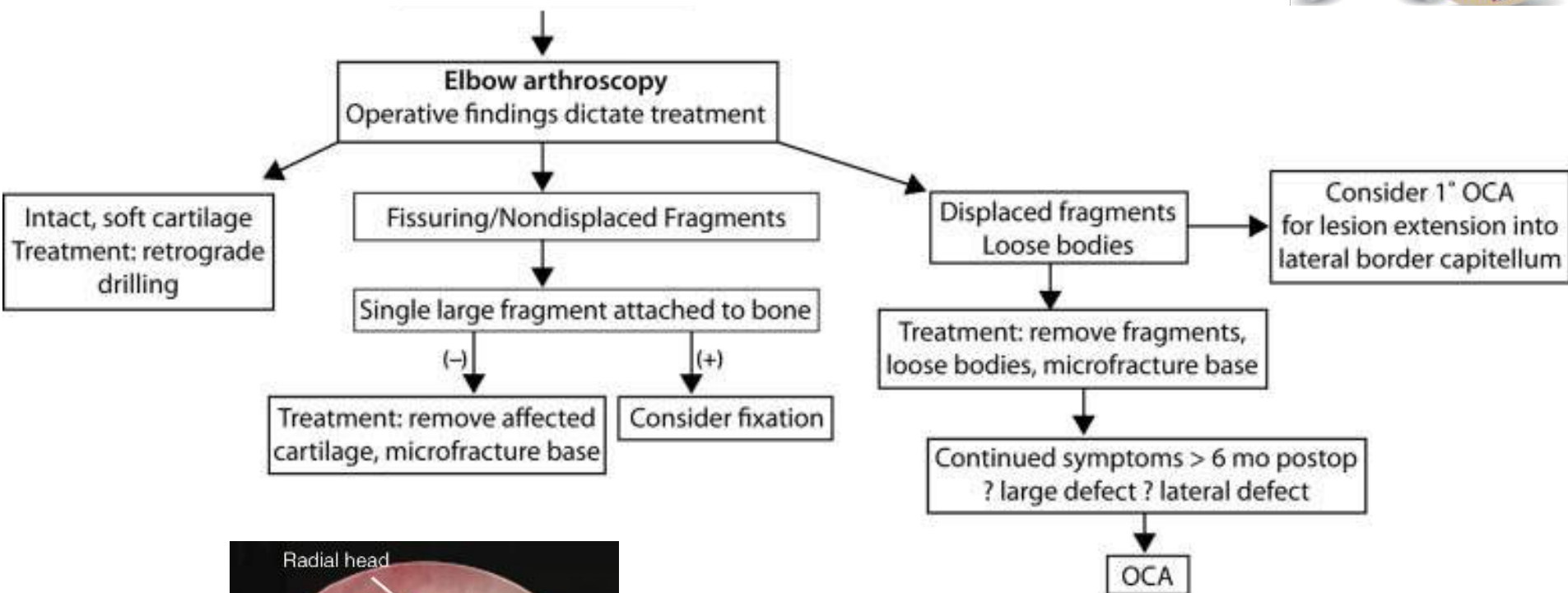
OCD - Imaging

- 45° flexion



Takahara, JBJS-A, 2008

OCD - behandeling



OCD- behandeling



Arthroscopic Surgery in Athletes With Osteochondritis Dissecans of the Elbow

Frank de Graaff, M.D., Matthijs R. Krijnen, M.D., Ph.D., Rudolf W. Poolman, M.D., Ph.D.
and W. Jaap Willems, M.D., Ph.D.

TABLE 1. *GRADE: Quality Assessment of Studies for Impact of Debridement, Drilling, Microfracturing, and Fragment Fixation*

Outcome	Author	Critical Appraisal										Results		
		A	B	C	D	E	F	G	H	I	J	K	L	
Quality assessment of studies for impact of debridement, drilling, microfracturing, and fragment fixation														
MAYO ¹⁶	Brownlow et al. ⁶	33	24	—	—	+	+	—	+	NA	94%	IV	Very low	
MAESS ^{8,15}	Rahusen et al. ¹⁰	15	45	+/-		+	+	—	+	+	93%	IV	Very low	
	Micheli et al. ⁸	47	56	—	—	—	—	—	—	NA	85%	IV	Very low	
Tivnon ¹⁸	Takeda et al. ¹¹	11	57	—	—	+	—	—	+	NA	91%	IV	Very low	
	Nobuta et al. ⁹	28	17	—	—	+	—	+	+	NA	86%	IV	Very low	
Quality assessment of studies for impact of debridement, drilling, microfracturing, fragment fixation, and osteochondral autografting														
SANE ¹⁷	Jones et al. ⁷	21	48	—	—	—	+	—	+	NA	87*	IV	Very low	
Timmerman ¹⁵	Mihara et al. ¹²	27	37	+/-	—	+	—	—	+	NA	100%	IV	Very low	
Quality assessment of studies for impact of osteochondral autografting														
Timmerman ¹⁵	Yamamoto et al. ¹⁴	18	42	+/-	—	+/-	—	—	+	NA	78%	IV	Very low	
	Iwasaki et al. ¹³	19	45	—	—	+	+	+	+	NA	95%	IV	Very low	

Abbreviations: A, number of patients; B, follow-up period (months); C, control group; D, randomization; E, standardization; F, selection bias; G, baseline characteristics; H, follow-up greater than 12 months; I, loss to follow-up; J, primary outcome (excellent/good score); K, level of evidence; L, conclusion; NA, not available.

*No percentage available.

De Graaff et al – arthroscopy - 2011



OCD - rehab



Debridement

- ROM direct postoperatief
- Sporten na 1-3 mdn

OATS

- 2 wkn gips
- Hierna opbouwen ROM
- Sporten na 3-6 mdn



OCD – return to sports



Return to Sport After Operative Management of Osteochondritis Dissecans of the Capitellum

A Systematic Review and Meta-analysis

Robert W. Westermann,^{*,†} MD, Kyle J. Hancock,[†] MD, Joseph A. Buckwalter
Benjamin Kopp,[†] BS, Natalie Glass,[†] PhD, and Brian R. Wolf,[†] MD, MS

Mean RTS 86%

Mean time 5.6 months



Studies

Debridement

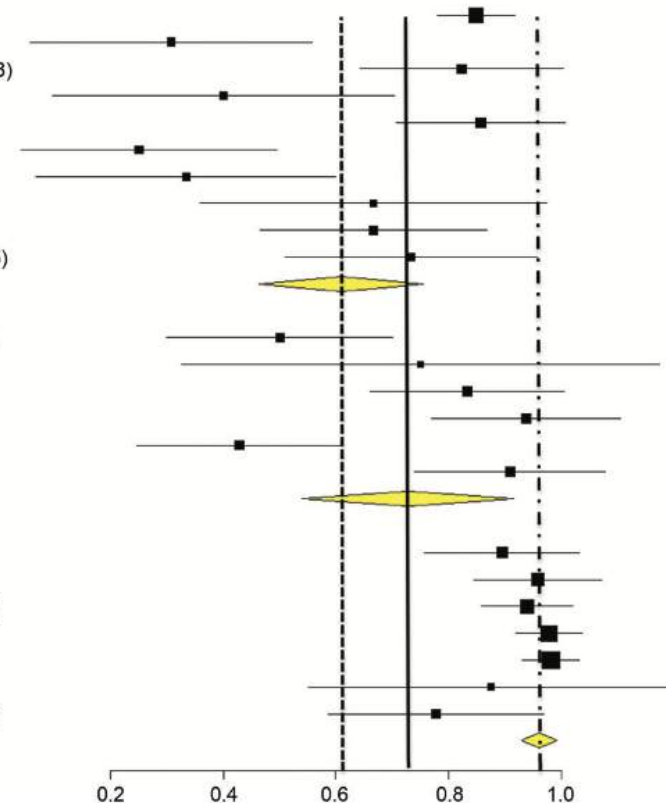
Miyake (2011)
Schoch (2010)
Baumgarten (1998)
Byrd (2002)
Jones (2010)
Ruch (1998)
Tivnon (1976)
Bojanić (2012)
Lewine (2015)
McManama (1985)

Fixation

Hennrikus (2015)
Harada (2002)
Uchida (2015)
Kuwahata (1998)
Nobuta (2008)
Takeda (2002)

OATS

Iwasaki (2009)
Lyons (2015)
Maruyama (2014)
Nishinaka (2014)
Shimada (2012)
Tsuda (2005)
Yamamoto (2006)



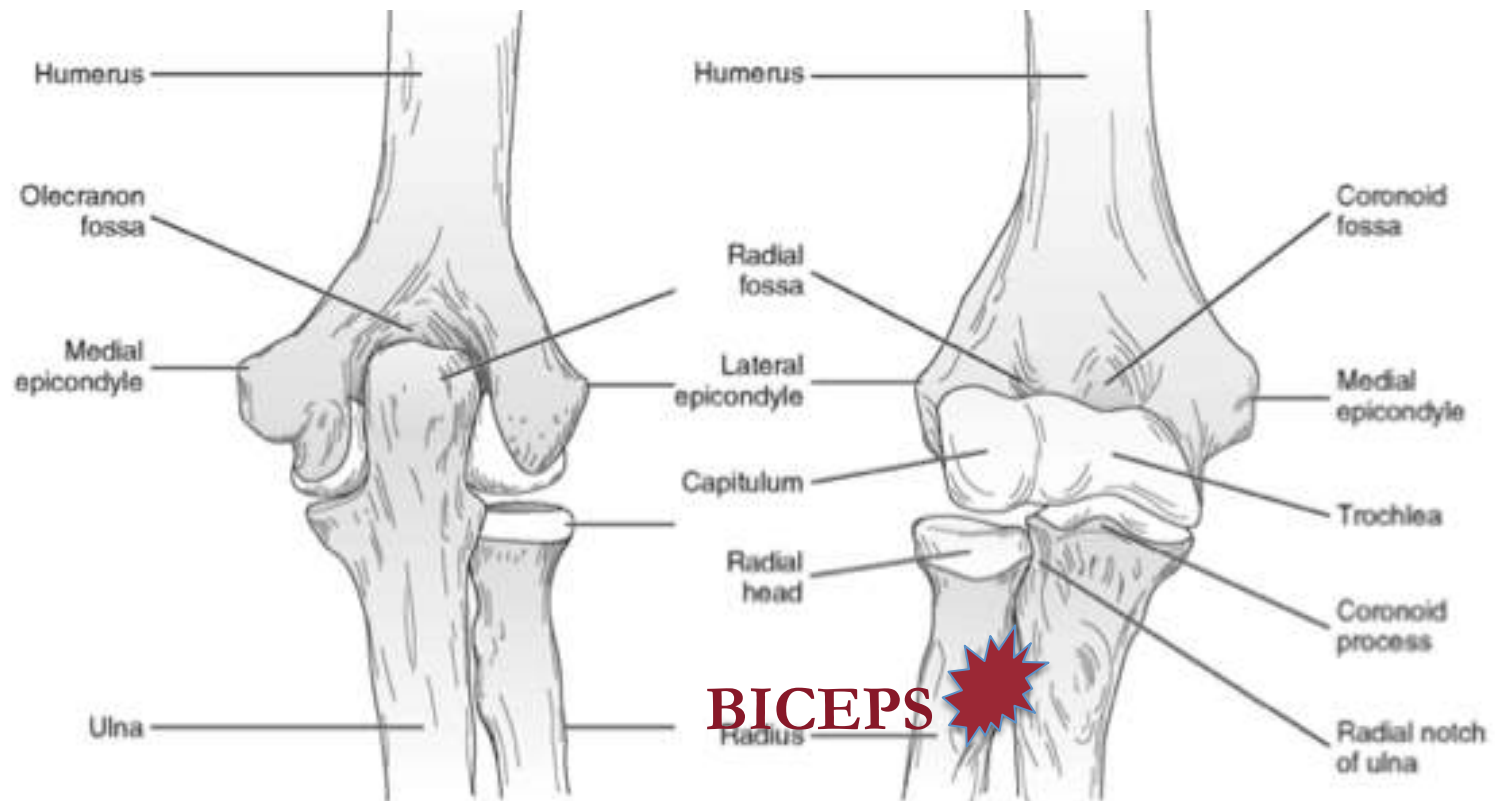
OCD - conclusie



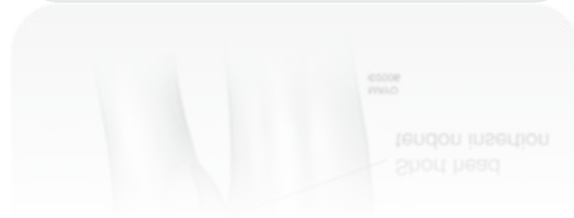
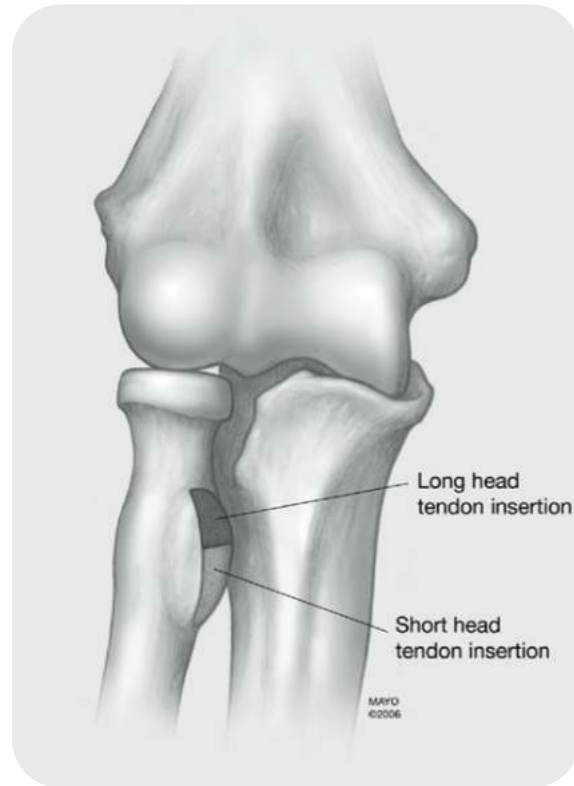
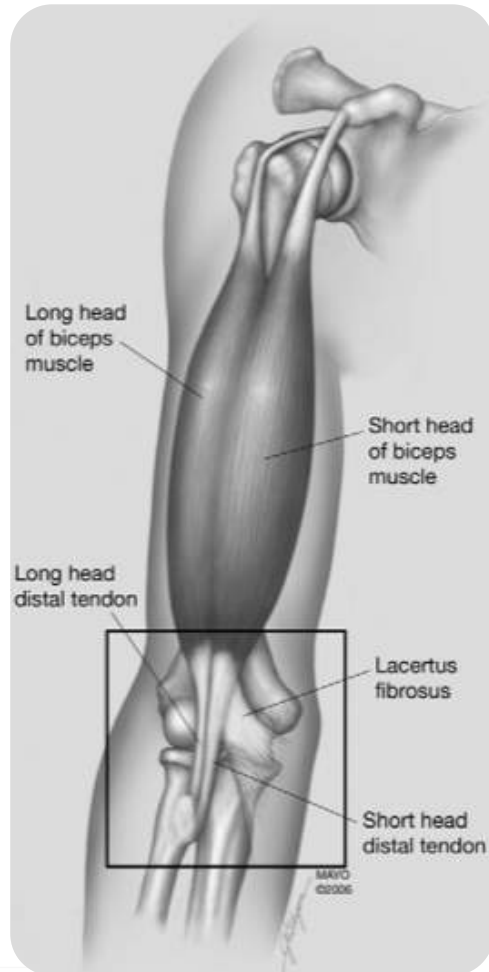
- MRI belangrijk voor indicatiestelling. Unstable = operatie!
- Verschillende operatietechnieken, lastig te vergelijken
- Huidige evidence very low
- RTS 62 – 95%



Blessures



Distale bicepspees - anatomie



Distale bicepspees - ruptuur

1. Mannen, dominante arm, 40 jaar, nicotine gebruik
Traumamechanisme: excessieve excentrische kracht op gebogen en geïsoleerde elleboog.
2. Chronische (partiële) degeneratieve ruptuur met toenemende leeftijd

Table I Isometric strength relative to contralateral arm

	Flexion	Supination	Grip
Operated	92.94 (54.4-139.00)	87.91 (42.42-139.00)	100.00 (24.41-270.04)
Nonoperated	70.65 (23.04-139.00)	59.11 (33.04-88.98)	79.16 (39.14-108.46)
<i>P</i> value	.00002	.00414	.16002

Bold values indicate statistical significance.

Table IV Mean patient scores

	QuickDASH	Oxford	Mayo
Operated	6.29 (0-31.8)	44.71 (35-48)	93.13 (70-100)
Nonoperated	14.10 (2.3-40.9)	38.70 (22-48)	84.50 (50-100)
<i>P</i> value	.02123	.00429	.01423

Bold values indicate statistical significance.



Hook test



D



E



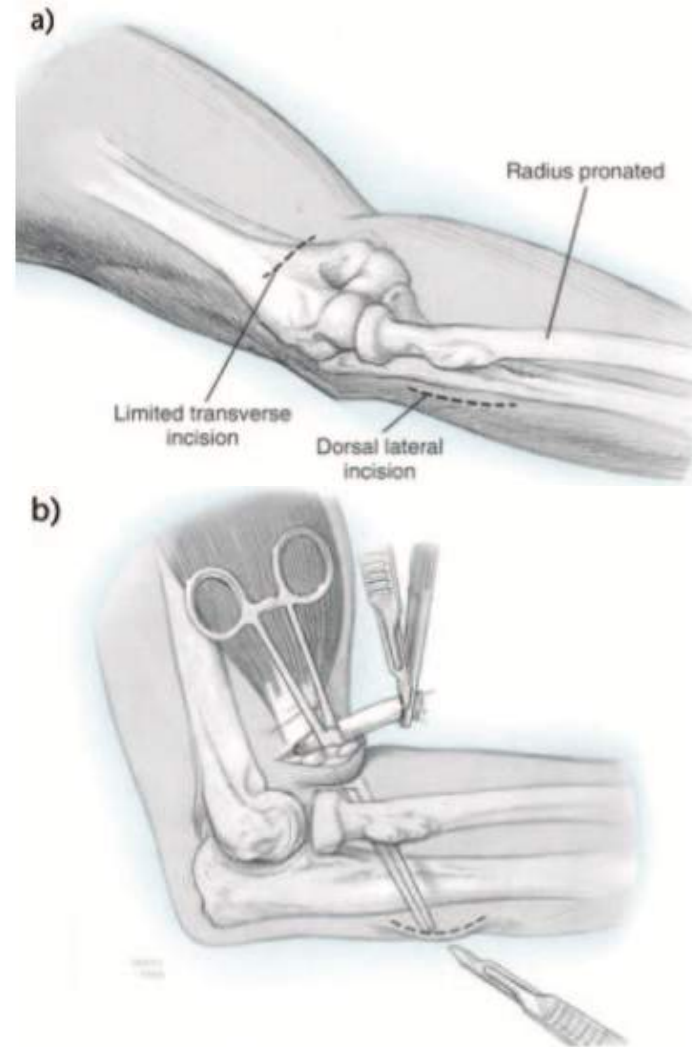
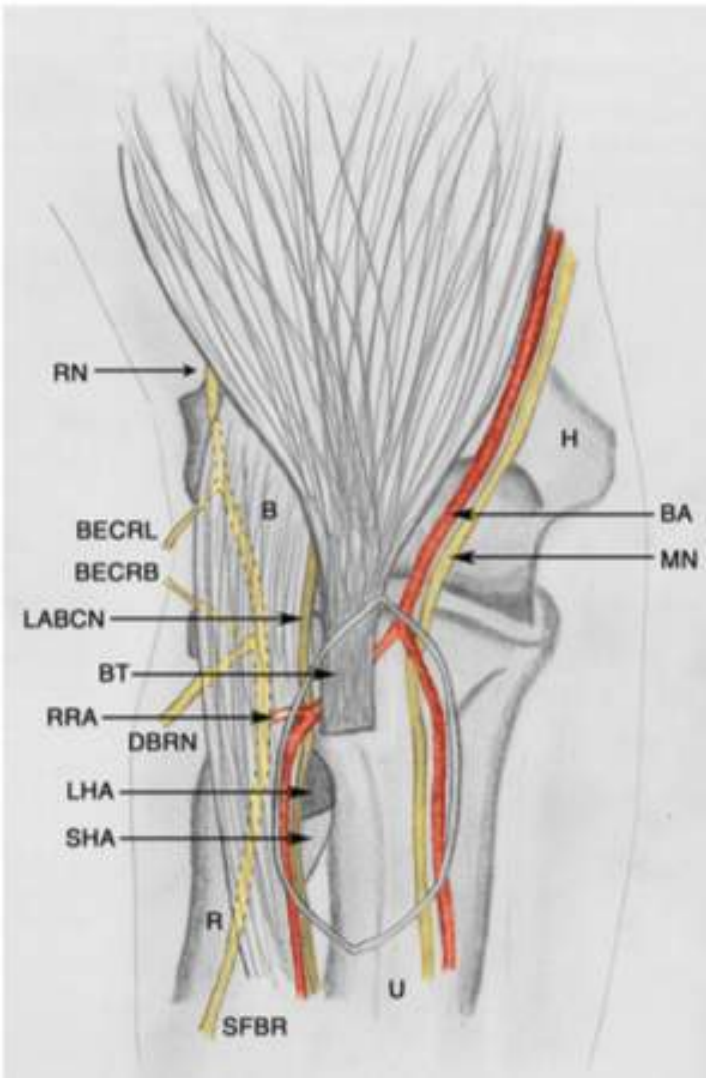
Distale biceps - Approach



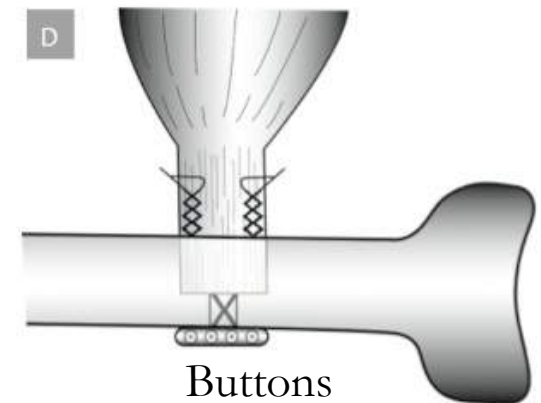
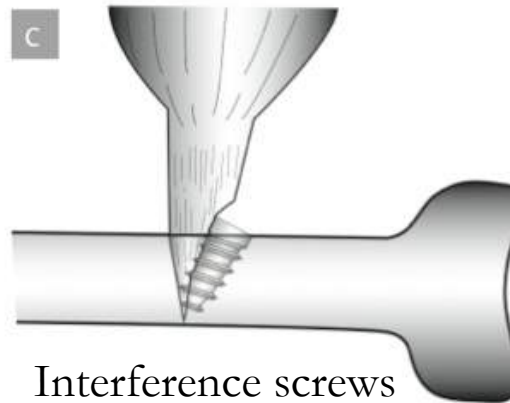
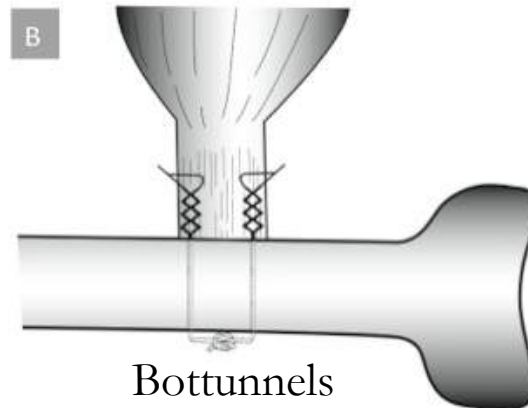
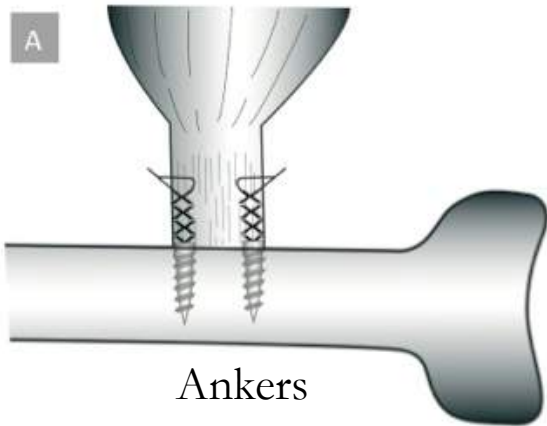
Single

VS

Double



Distale biceps - reconstructie





Neurologie

Refixation techniques and approaches for distal biceps tendon ruptures: a systematic review of clinical studies

Izaak F. Kodde, MD^{a,b,*}, Remco C. Baerveldt, MD^{c,1}, Paul G.H. Mulder, PhD^d, Denise Eygendaal, MD, PhD^b, Michel P.J. van den Bekerom, MD^e

Table III Neurologic complications

Group *	No. of patients	Neurapraxia [†]												Total No. (%)
		Deep branch of radial nerve		Posterior interosseous nerve		Superficial branch of radial nerve		Lateral antebrachial cutaneous nerve		Median nerve		Unspecified nerve		
		>6 months	<6 months	>6 months	<6 months	>6 months	<6 months	>6 months	<6 months	>6 months	<6 months	>6 months	<6 months	
A	565	1	6	0	2	1	8	8	40	1	0	1	5	73 (13)
B	321	0	1	0	3	0	1	0	13	1	0	0	1	20 (6)
C	42	0	0	0	2	2	8	0	8	0	0	0	0	20 (48)
D	146	0	4	1	7	0	2	1	19	0	0	0	0	24 (17)
Anterior 2-incision	764	1	9	1	12	3	18	9	66	2	0	1	5	127 (17)
Acute [‡]	310	0	2	0	2	0	1	0	14	0	0	0	1	20 (6)
Delayed	670	1	7	0	8	3	17	7	41	2	0	1	6	61 (10)
>6 month	90	0	1	0	1	0	2	0	9	0	0	0	0	13 (14)
<6 month		1		1		3		9 [§]		2		1		17 (2)
Total	1074	1	11	1	14	3	19	9	80	2	0	1	6	130 (12)
														147 (14)

* Fixation group: A, suture anchor; B, bone tunnels; C, interference screw; D, cortical button.

[†] Neurapraxias are ordered by the duration of the complication (<6 months or >6 months).

[‡] Not all included studies reported the delay between injury and surgery; therefore, only 760 patients were used for these calculations.

[§] Surgical exploration was performed in 1 case.

^{||} Surgical exploration was performed in both cases.

Heterotope ossifications



Table IV Other complications

Fixation group*	No. of patients	Heterotopic ossification†		Infection		Rerupture	Wound healing disorder	Other‡	Total No. (%)
		Severe	Mild	Deep	Superficial				
A	565	10	73	2	4	12	5	24	130 (23)
B	321	3	19	1	1	5	9	4	42 (13)
C	42	0	0	0	0	1	0	3	4 (10)
D	146	2	17	0	2	2	4	7	34 (23)
Anterior 2-incision	764	12	101	3	6	16	8	31	177 (23)
Total	1074	3	8	0	1	4	10	7	33 (11)
		1074		3	7	20	18	38	210 (20)

* Fixation group: A, suture anchor; B, bone tunnels; C, interference screw; D, cortical button.

† Heterotopic ossification was classified as severe if it was associated with pain or caused a loss of $>30^\circ$ of motion in any plane and mild if it was associated with no pain or caused a loss of $<30^\circ$ of motion in any plane.

‡ Other complications consisted of stiffness ($n = 4$), complex regional pain syndrome ($n = 4$), radioulnar synostosis ($n = 1$), persistent pain ($n = 11$), displacement of fixation material ($n = 9$), tendinitis ($n = 3$), capsulitis of ipsilateral shoulder ($n = 1$), awareness of fixation material ($n = 2$), elongation of the biceps tendon ($n = 1$), and carpal tunnel syndrome ($n = 2$).



Single Versus Double-Incision Technique for the Repair of Acute Distal Biceps Tendon Ruptures

A Randomized Clinical Trial

Ruby Grewal, MD, MSc, FRCSC, George S. Athwal, MD, FRCSC, Joy C. MacDermid, BScPT, MSc, PhD,
Kenneth J. Faber, MD, MHPE, FRCSC, Darren S. Drosdowech, MD, FRCSC,
Ron El-Hawary, MD, MSc, FRCSC, and Graham J.W. King, MD, MSc, FRCSC

Conclusions: There were no significant differences in outcomes between the single and double-incision distal biceps repair techniques other than a 10% advantage in final flexion strength with the latter. Most complications were minor, with a significantly greater prevalence in the single-incision group.

TABLE III Complications

	Single Incision (N = 47)	Double Incision (N = 43)	P Value
Neurapraxias			<0.001
Any symptoms	19	3	
Symptoms >6 mo	3	0	
Tendon rerupture	3	1	0.3
Grade-1 heterotopic ossification	1 (did not receive prophylaxis)	1 (received prophylaxis)	0.7

Distale biceps - rehab



J Shoulder Elbow Surg (2016) ■ ■ ■ ■ ■



Does immediate elbow mobilization after distal biceps tendon repair carry the risk of wound breakdown, failure of repair, or patient dissatisfaction?

James R.A. Smith, MBBS, BSC, MRCS*, Rouin Amirfeyz, MD, MSc, FRCS

Immediate Active Range of Motion After Modified 2-Incision Repair in Acute Distal Biceps Tendon Rupture

Akin Cil, MD, Sheri Merten, RN, and Scott P. Steinmann,* MD
From the Department of Orthopaedic Surgery, Mayo Clinic, Rochester, Minnesota

Gips???

Wk 1-6: direct actief oefenen ROM

Wk 6-12: kracht op gaan bouwen

Wk > 12: return to sports



Distale biceps – return to sports



Repair of distal biceps tendon ruptures in athletes*

DONALD F. D'ALESSANDRO,† MD, CLARENCE L. SHIELDS, JR, MD,
JAMES E. TIBONE, MD, AND ROBERT W. CHANDLER, MD

Patients were extremely pleased with the results of operative repair and uniformly graded their subjective result as excellent. On a 10-point scale, the group mean rating was 9.75, with a minimum of 9.5. All patients returned to unlimited activities and experienced no pain. One patient later placed in the top 10 winners of a national body building competition, and another patient won a national arm wrestling championship using the operated arm. Four patients had occasional fatigue with extreme repetitive use of the extremity.



Return to work



Primary Repair of Traumatic Distal Biceps Ruptures in a Military Population: Clinical Outcomes of Single- Versus 2-Incision Technique

Brian R. Waterman, M.D., Lorenzo Navarro-Figueroa, P.A., and Brett D. Owens, M.D.

statistically significant ($P > .05$). **Conclusions:** Among active patients, a single—volar incision technique and a 2-incision technique showed similar complication profiles. Rerupture and persistent elbow dysfunction were uncommon, but adverse outcomes were significantly more likely among patients who used tobacco. Anatomic distal biceps repair is a safe surgical procedure with excellent clinical outcomes and a 96.6% rate of return to preoperative military function without restrictions. **Level of Evidence:** Level III, retrospective comparative study.



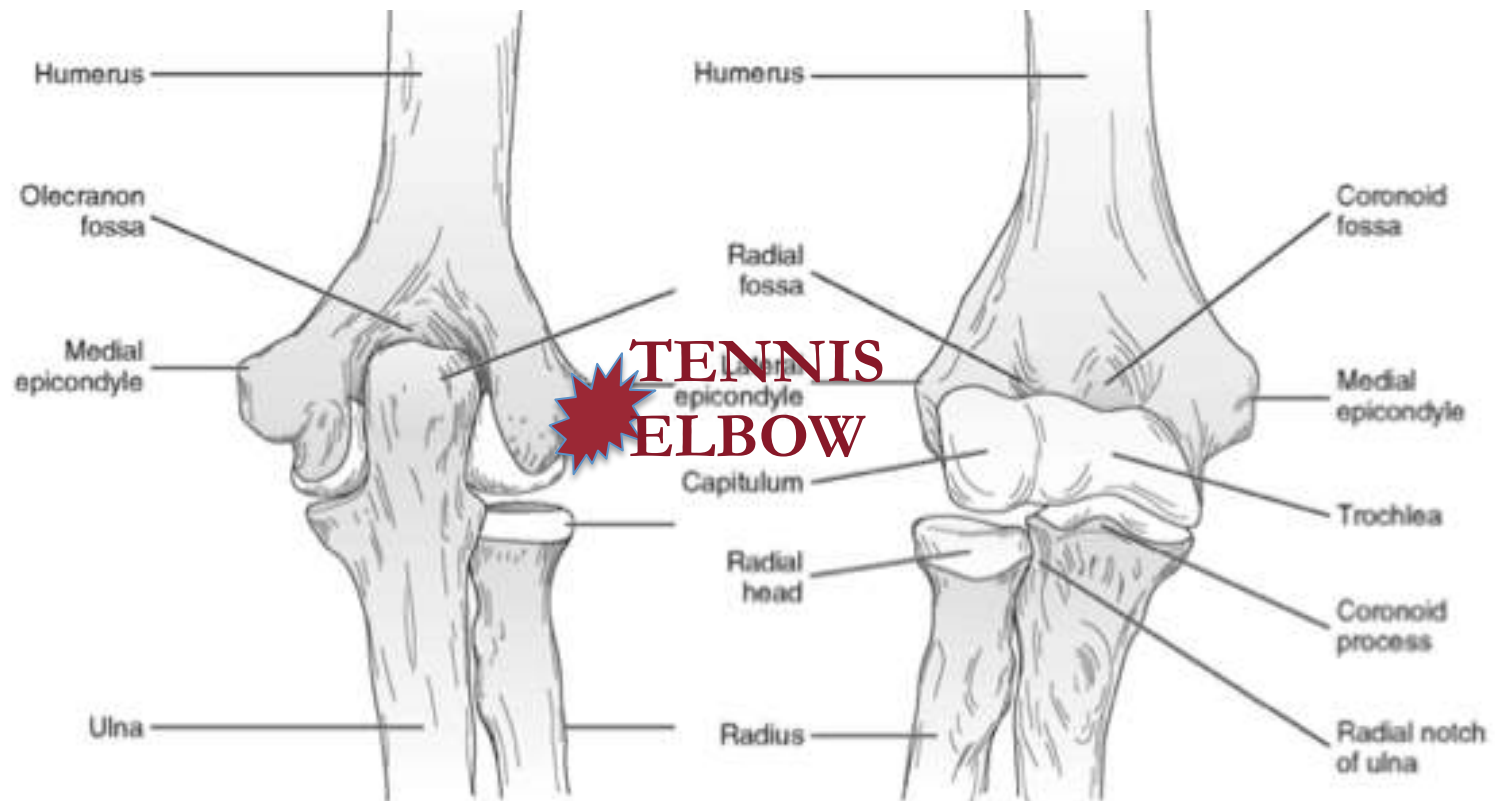
Distale biceps - conclusie



- Reconstructie aanbevolen voor alle actieve mensen
- Veel verschillende technieken en benaderingen
 - Kracht, ROM, etc gelijk
 - Minder complicaties na 2-incisie...
- Rehab zou wrs agressiever kunnen dan nu gebruikelijk.
- RTS tot 100%. Echter nauwelijks beschreven.



Blessures



Tennis elleboog



GP practice

Incidence: 5-8/1000/yr

40-50 yrs old: 13/1000/yr

Males = females

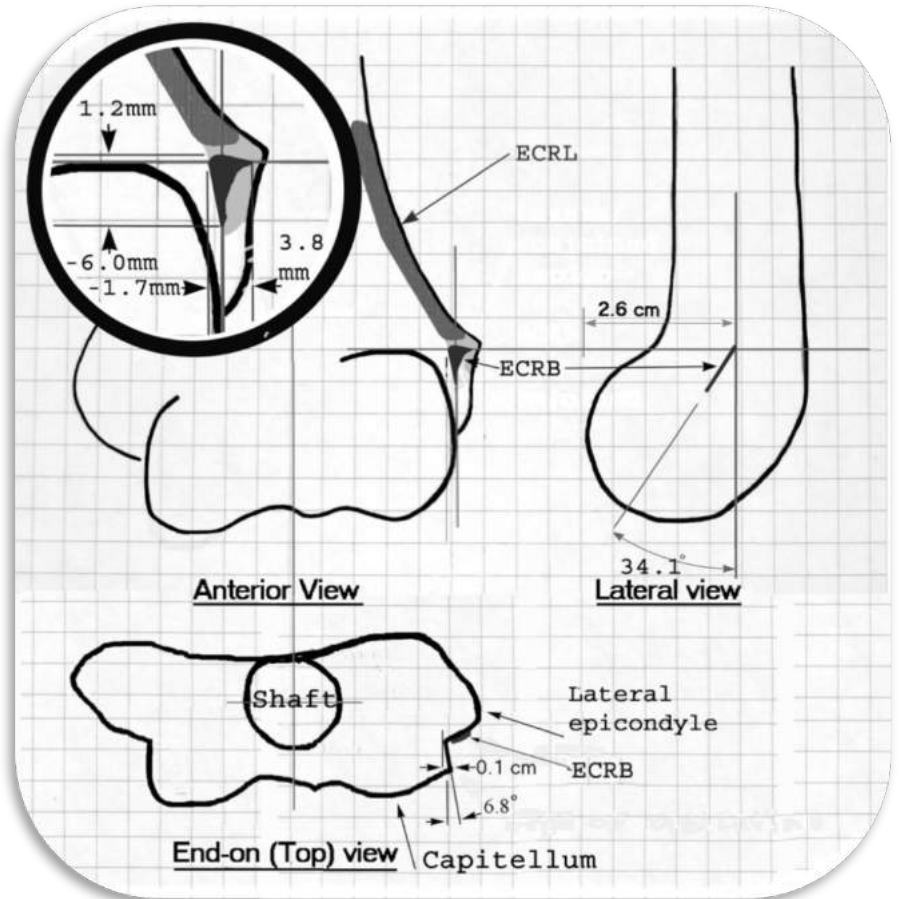
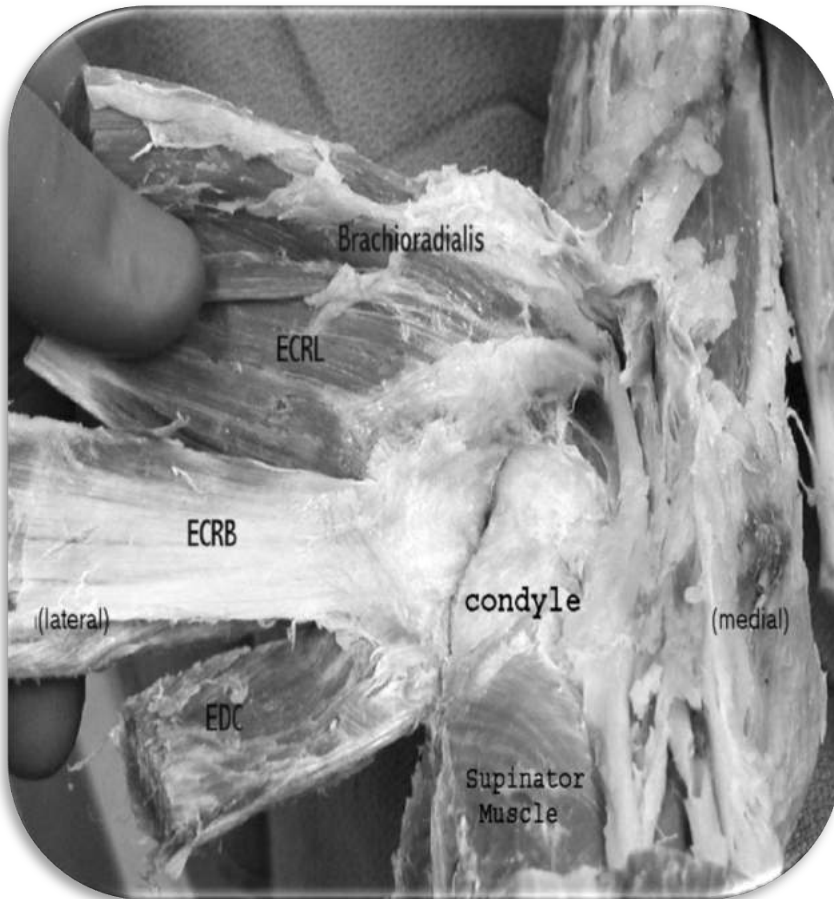
Lateral : medial = 8 : 1



NHG standard epicondylitis, 2009



Tennis elleboog



Bunata et al - *JBJS Am* - 2007

Natural history



80% resolution after 6 months

90% resolution after 1 year

Less favourable prognosis:

- long-term complaints
- severe pain
- dominant arm
- recurrence



NHG standard epicondylitis, 2009



Surgery

- Inability to return to usual activities
- Only after minimum of 6 months – 1 year
- 10% of patients



Associated Pathologies



Synovitis

55%

Bone spurs (osteophytes)

12%

Loose bodies

7%

Degenerative disease

2%



Kaminskey & Baker, 2006

Conclusion: ECRB



No single conservative intervention most effective

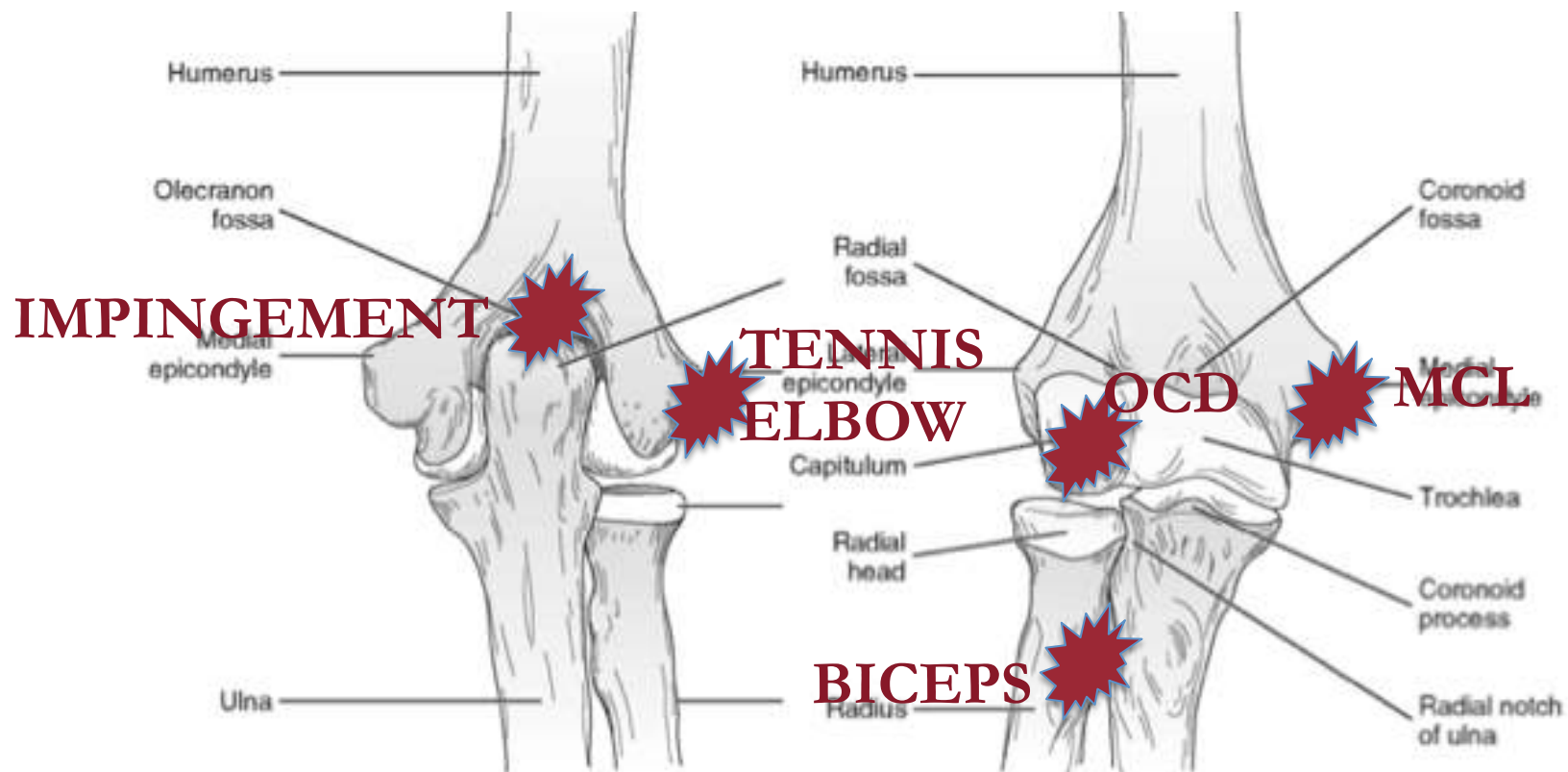
Surgical treatment success rates 80%, regardless of the method of treatment / surgical approach, but low level of evidence

Arthroscopy:

- Address intra-articular pathology (20%)
- Earlier return to work & sport
- 2x longer OR time



Blessures



Maar uiteindelijk...



Thank You!

