Top 5 Sports Medicine topics for the Primary Care provider

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Objectives

To identify common musculoskeletal pathologies that present to the primary care setting

- Knee: Meniscus tear
- Ankle: Ankle sprain
- Head: Concussion
- Shoulder: Impingement/Rotator cuff
- Elbow: Tennis elbow

To review high-yield clinical exam skills for common musculoskeletal injury

To discuss evidence-based treatment algorithms for common musculoskeletal injury

Why does it Matter?- Knee

- Meniscus Tears
  - Affects 25% of adults
  - Accounts for nearly 4 million primary care visits annually
  - Incidence of meniscal tears 60 in 100,000
    - Meniscal-related surgeries 17 in 100,000

- Bunt CW, Jonas CE, Chang JG. Knee Pain in Adults and Adolescents: The Initial Evaluation. Am Fam Physician. 2018 Nov 1;98(9):576-585. PMID: 30325638.
- Luvsannyam E, Jain MS, Leitao AR, Maikawa N, Leitao AE. Meniscus Tear: Pathology, Incidence, and Management. Cureus. 2022 May 18;14(5):e25121. doi: 10.7759/cureus.25121. PMID: 35733484; PMCID: PMC9205760.

Why Does it Matter?- Ankle

- Ankle Sprains
  - 30,000 ankle sprains occur daily in the US; >3 million/yr
    - <50% seek medical care
  - Incidence rate of 2.15/1000
  - 25% of sport injuries are foot and ankle related
  - Economic burden >$4Billion/year
  - 80% of Lateral Ankle Sprains are of the inversion type, and 75% lead to recurrence and instability

- Cavazos GJ Jr., Harkless LB. The epidemiology, evaluation, and assessment of lateral ankle sprains in athletes. J Sports Med Ther. 2021; 6: 008-017.

Why Does it Matter?- Brain

- Concussions
  - In 2020, 6.8% of children aged 17 years and under had ever had symptoms of a concussion or brain injury.
  - 1-3million concussions/year
  - >50% of concussions assessed by primary care providers
  - ~214,110 TBI-related hospitalizations in 2020 and 69,473 TBI-related deaths in 2021.
    - People age 75 years and older had the highest numbers and rates of TBI-related hospitalizations and deaths. This age group accounts for about 32% of TBI-related hospitalizations and 28% of TBI-related deaths

- https://www.cdc.gov/nchs/products/databriefs/db423.htm
- Centers for Disease Control and Prevention. National Center for Health Statistics: Mortality Data on CDC WONDER. Accessed April 2023, https://wonder.cdc.gov/mcd.html.
- Assessment and Management of Sport-Related Concussions in United States High Schools Meehan, William P.;d'Hemecourt, Pierre;Collins, Christy L.;Comstock, R. Dawn; Am J Sports Med. 2011; 39(11):2304-2310 URL : https://stacks.cdc.gov/view/cdc/33371

Why Does it Matter?- Shoulder

- Impingement/Rotator Cuff Pathology
  - Rotator cuff disease affects between 6.8 and 22.4% of the population over the age of 40
  - Total prevalence of partial (23%) and full thickness (49%) tears
  - In MRIs of asymptomatic patients >40yo, >10% have full thickness tears
  - ~50% of RTC tears progress with age
  - ~5% of RTC tears proceed to surgery (ie: most non-op management)
  - Indirect and direct healthcare costs of failed primary RTC repair in 2022→~$440 million
  - ~1-2.4% of visits to primary care for new onset shoulder pain
    - Of these visits ~65% related to RTC tears/tendinopathy

- Prevalence, Natural History, and Nonoperative Treatment of Rotator Cuff Disease, Operative Techniques in Sports Medicine,Volume 31, Issue 1, 2023, https://doi.org/10.1016/j.otsm.2023.150978
- Parikh N, Martinez DJ, Winer I, Costa L, Dua D, Trueman P. Direct and indirect economic burden associated with rotator cuff tears and repairs in the US. Curr Med Res Opin. 2021 Jul;37(7):1199-1211. doi: 10.1080/03007995.2021.1918074. Epub 2021 May 19. PMID: 33879008.
- Mathiasen R, Hogrefe C. Evaluation and Management of Rotator Cuff Tears: a Primary Care Perspective. Curr Rev Musculoskelet Med. 2018 Mar;11(1):72-76. doi: 10.1007/s12178-018-9471-6. PMID: 29350325; PMCID: PMC5825352.

Why Does it Matter?- Elbow

- Tennis Elbow (Lateral Epicondylitis)
  - Incidence 3.4/1000 patients
    - Higher incidence in age groups 40-49, 50-59
  - Recurrence rate within 2 years; 8.5%
  - ~10% of patients with persistent symptoms at 6 months require surgery
  - ~1-3% of visits to primary care for elbow pain
  - A second encounter with a physician for tennis elbow was a strong predictor of increased treatment cost due to specialist referral, use of physical therapy, or treatment with steroid injection

- Degen RM, Conti MS, Camp CL, Altchek DW, Dines JS, Werner BC. Epidemiology and Disease Burden of Lateral Epicondylitis in the USA: Analysis of 85,318 Patients. HSS J. 2018 Feb;14(1):9-14. doi: 10.1007/s11420-017-9559-3. Epub 2017 Jun 5. PMID: 29398988; PMCID: PMC5786580.
- Sanders TL Jr, Maradit Kremers H, Bryan AJ, Ransom JE, Smith J, Morrey BF. The epidemiology and health care burden of tennis elbow: a population-based study. Am J Sports Med. 2015 May;43(5):1066-71. doi: 10.1177/0363546514568087. Epub 2015 Feb 5. PMID: 25656546; PMCID: PMC4517446.
- Sanders TL, Maradit Kremers H, Bryan AJ, Ransom JE, Morrey BF. Health Care Utilization and Direct Medical Costs of Tennis Elbow: A Population-Based Study. Sports Health. 2016 Jul;8(4):355-8. doi: 10.1177/1941738116650389. Epub 2016 May 23. PMID: 27215568; PMCID: PMC4922520.

Pre-learning quiz

- True or False?
  - Most meniscal tears in patients <30 years of age are due to degenerative arthritis

Pre-learning quiz

- The talar tilt test, tests the stability of which ankle ligament?
  - Deltoid ligament
  - CFL
  - Tib-Talar ligament
  - Maisonneuve ligament

Pre-learning quiz

- True or False?
  - Approximately 45% of patients have recovered from concussion by 4 weeks post-injury

Pre-learning quiz

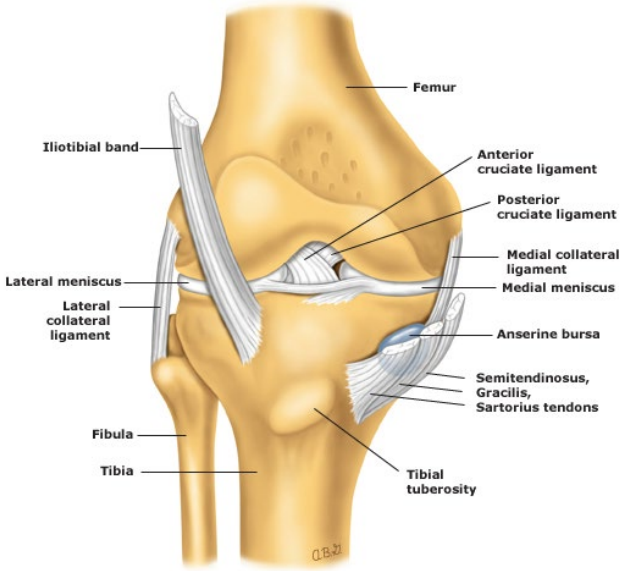
- Approximately what percentage of partial thickness rotator cuff tears progress to full thickness tears within 3 years?
  - 100%
  - 40%
  - 75%
  - 10%

Pre-learning quiz

- Which of the following conditions can sometimes mimic the initial symptoms of lateral epicondylitis?
  - Radial tunnel syndrome
  - Cubital tunnel syndrome
  - Carpal tunnel syndrome
  - C2 Cervical radiculopathy
  - Golfer’s elbow

Meniscus Injury

Knee Anatomy



This drawing represents an anterior view of the knee with the patella removed and demonstrates the relationship between the bones, menisci, and major ligaments.
Graphic 69611 Version 9.0

Knee Injury- Meniscus

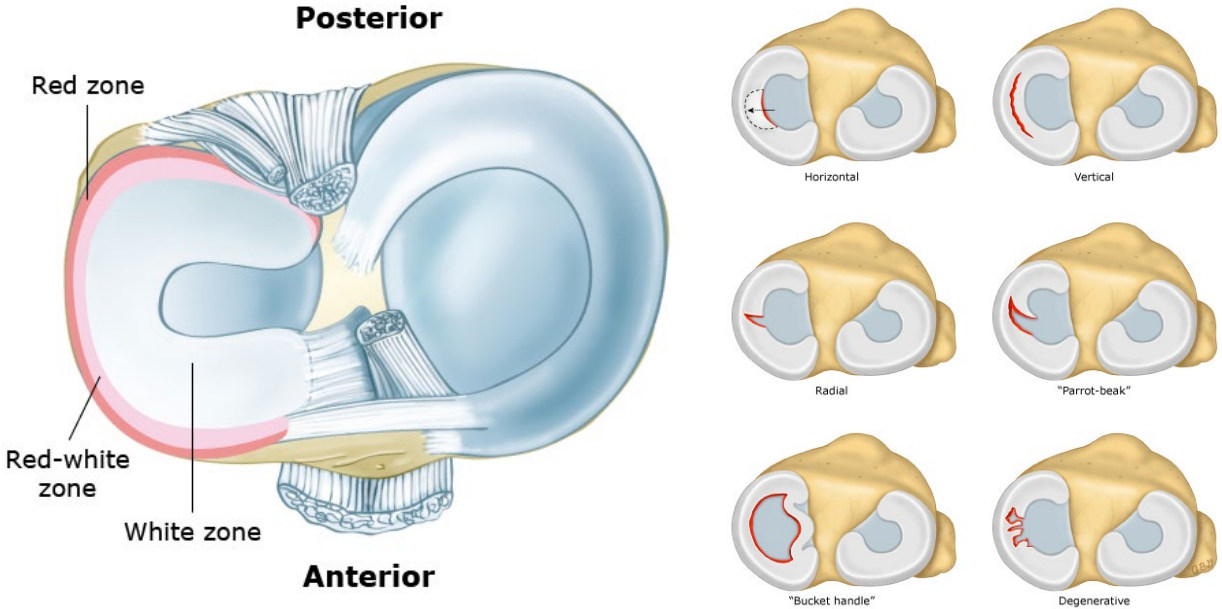
- Knee injuries account for nearly 1/3 all sports injuries
- Meniscal injuries are very common
  - 6.1 per 1000 patients (1/3 being sports-related)
  - 8:1 medial: lateral
- Diagnosis can be made by history 75% of the time
- Horizontal tears may be asymptomatic
- Vertical or complex tears more symptomatic
- <30 years typically traumatic and peripheral tears
- >30 years more complex and degenerative patterns

Greenman, P. Principles of Manual Medicine, 3rd edition
Wagemakers, HPA, et al Clin J Sport Med 2008;18:24–30 Shrier, I., et al. Curr. Sports Med. Rep. 2010; 9(5): 284-289.

Physical Exam- Knee

- Meniscus
  - McMurrays
  - Bounce
  - Apley
  - Thessaly
- MCL
  - Valgus (0 and 30^0)
- LCL
  - Varus (0 and 30^0)
- ACL
  - Lachman
  - Anterior Drawer
- PCL
  - Posterior Drawer
  - Posterior Lachman
  - Sag sign
- PLC
  - External Rotation Recurvatum test
  - Dial (30 and 90^0)
- Patellar

Knee Injury- Meniscus

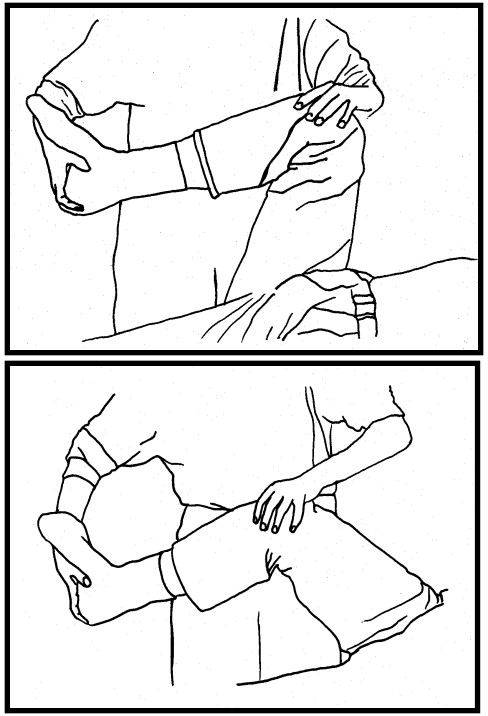


Reproduced with permission from: Milewski MD, Coene RP, Wilson PL. Meniscus repair techniques, including bucket-handle tears. In: Operative Techniques in Pediatric Orthopaedic Surgery, 3rd ed, Flynn JM, Sankar WN (Eds), Lippincott Williams & Wilkins 2021. Copyright © 2021 Wolters Kluwer Health, Inc.

Graphic 145536 Version 1.0

Knee—Meniscus McMurray's Test

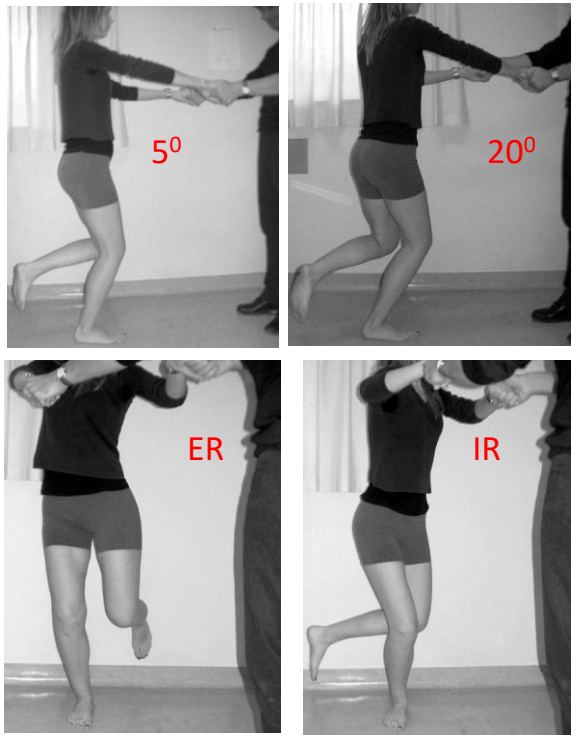
- Knee flexed on the side to be tested
- With right hand, ER the tibia and straightens the leg
- Straightening (extension) drives the medial meniscus anteriorly
- An audible or palpable click is a positive test
  - Sens 16-58%/Spec 77-98%
- *Medial-Lateral Grind Test* may augment with valgus/varus stress
- *Bragard sign* is reduced pain with full flexion suggesting an anterior tear



Shrier, I., et al. Curr. Sports Med. Rep. 2010; 9(5): 284-289.

Knee—Meniscus Thessaly Test

- Patient rotates knee and body internally and externally
- IR of the body produces ER of the tibia and medial joint-line pain when the medial meniscus is torn
- Patients may experience joint-line discomfort and may have a sense of locking or catching



Karachalios, T, et al. J Bone Joint Surg 2005; 87-A: 955-962
Harrison, BK, et al. Clin J Sports Med 2008; 18: 185

Knee—Meniscus

- Apley Compression/ Distraction Test
  - Sen 13-16%; Spec 80-90%
- Joint line Tenderness
  - Sen 71-78%; Spec 87-90%
- Bounce
  - Sen 44%: Spec 95%

Malanga, GA Musculoskeletal Physical Examination; Elsevier:Philadelphia, 2006
http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=physmedrehab&part=A5126

MRI vs Clinical Exam for Meniscus

- Results of 5 studies favored routine use of MRI
  - Accuracy of PE 44-78%
  - Accuracy of MRI 68-96%
- Results of 7 studies concluded that routine MRI was unnecessary if examiner experienced orthopedist
  - McMurray, Apley, Thessaly, joint line tenderness
  - Only 9% of arthroscopically confirmed tears not dx
- Concomitant ligamentous injury, severe joint degeneration, and/or occult dx reduced accuracy

CJSM 2008; 18: 377
Clin Orthop 2007; 24:123-133

Knee—Meniscus Tear

TABLE 5. Diagnostic Values (With 95% Confidence Intervals) of Isolated Determinants and Combinations of Determinants With Meniscal Tears (Prevalence = 0.35)

Variable	TP	SE	SP	PVP	PVN	LR+	LR−
History							
Age over 40 years	33	0.70 (0.57–0.83)	0.64 (0.54–0.74)	0.52 (0.39–0.64)	0.80 (0.71–0.89)	2.0 (1.4–2.8)	0.5 (0.3–0.7)
Continuation of activity impossible	28	0.64 (0.49–0.78)	0.55 (0.45–0.66)	0.43 (0.31–0.55)	0.74 (0.63–0.85)	1.4 (1.0–2.0)	0.7 (0.4–1.0)
Weight bearing during trauma	35	0.85 (0.75–0.96)	0.35 (0.24–0.46)	0.43 (0.32–0.53)	0.80 (0.67–0.95)	1.3 (1.1–1.6)	0.4 (0.2–0.9)
Physical examination							
Pain at passive flexion	36	0.77 (0.64–0.89)	0.41 (0.31–0.52)	0.41 (0.31–0.52)	0.77 (0.64–0.89)	1.3 (1.0–1.7)	0.6 (0.3–1.0)
Combinations of determinants							
History ≥ 1 out of 3	45	0.96 (0.90–1.00)	0.14 (0.06–0.21)	0.39 (0.30–0.48)	0.81 (0.65–1.00)	1.1 (1.0–1.2)	0.3 (0.1–1.4)
History ≥ 2 out of 3	30	0.64 (0.50–0.78)	0.46 (0.35–0.57)	0.41 (0.30–0.52)	0.69 (0.56–0.81)	1.2 (0.9–1.6)	0.8 (0.5–1.2)
History = 3 out of 3	9	0.19 (0.08–0.30)	0.93 (0.87–0.98)	0.60 (0.35–0.85)	0.66 (0.57–0.75)	2.6 (1.0–6.7)	0.9 (0.8–1.0)
History ≥ 1 + physical exam	34	0.72 (0.60–0.85)	0.47 (0.36–0.58)	0.45 (0.34–0.56)	0.74 (0.62–0.86)	1.4 (1.0–1.8)	0.6 (0.4–1.0)
History ≥ 2 + physical exam	21	0.45 (0.30–0.59)	0.68 (0.58–0.78)	0.46 (0.31–0.60)	0.67 (0.57–0.77)	1.4 (0.9–2.2)	0.8 (0.6–1.1)
History = 3 + physical exam	7	0.15 (0.05–0.25)	0.97 (0.94–1.00)	0.78 (0.51–1.00)	0.66 (0.57–0.74)	5.8 (1.3-26.8)	0.9 (0.8–1.0)

TP, true positive; Se, sensitivity; SP, specificity; PVP, predictive value-positive; PVN, predictive value-negative; LR+, positive likelihood ratio; LR−, negative likelihood ratio.

Wagemakers, HPA, et al Clin J Sport Med 2008;18:24–30

TABLE 1. Sensitivity and specificity for several tests recently evaluated as diagnostic tests for meniscal tears in meta-analyses or systematic reviews (above solid line) or that included Thessaly test at 20° flexion (below solid line).

	Study	Joint Line Tenderness	McMurray	Apley	Thessaly at 20°
Meta-analyses					
Sensitivity	Malanga *et al.* 2003 (20) (range)	0.55–0.85	0.16–0.58	0.13–0.16	
	Hegedus *et al.* 2007 (13)	0.63 (0.61, 0.66)	0.71 (0.67, 0.73)	0.61 (0.56, 0.66)	
	Meserve *et al.* 2008 (22)	0.76 (0.73, 0.80)	0.55 (0.50, 0.60)	0.22(0.17, 0.28)	
Specificity	Malanga *et al.* 2003 (20) (range)	0.29–0.67	0.77–0.98	0.80–0.90	
	Hegedus *et al.* 2007 (13)	0.77 (0.76, 0.79)	0.71 (0.69, 0.73)	0.70 (0.68, 0.72)	
	Meserve *et al.* 2008 (22)	0.77 (0.64, 0.87	0.77 (0.62, 0.87)	0.88 (0.72, 0.96)	
Diagnostic Odds Ratio	Malanga *et al.* 2003 (20)	Not provided			
	Hegedus *et al.* 2007 (13)	4.5 (3.8, 5.4)	4.5 (3.7, 5.4)	3.4 (2.6, 4.4)	
	Meserve *et al.* 2008 (22)	11.0 (3.0, 39.9)	4.0 (1.0, 15.3)	2.2 (0.3, 17.7)	
Individual Studies Examining the Thessaly Test					
Sensitivity	Karachalios *et al.* 2005 (15)	0.71 MM, 0.78 LM	0.48 MM, 0.65 LM	0.41 MM, 0.41 LM	0.89 MM[a], 0.92 LM[b]
	Harrison *et al.* 2009 (12)				0.90
	Konan *et al.* 2009 (16)	0.83 MM, 0.68 LM	0.50 MM, 0.32 LM		0.59 MM, 0.32 LM
	Konan *et al.* 2009 (16)[c]	0.56 MM, 0.57 LM	0.25 MM, 0.14 LM		0.44 MM, 0.50 LM
	Mirzatolooei *et al.* 2010 (23)[c,d]	0.92[d]	0.51[d]		0.79
Specificity	Karachalios *et al.* 2005 (15)	0.87 MM, 0.90 LM	0.94 MM, 0.86 LM	0.93 MM, 0.86 LM	0.97 MM, 0.96 LM
	Harrison *et al.* 2009 (12)				0.98
	Konan *et al.* 2009 (16)	0.76 MM, 0.97 LM	0.77 MM, 0.94 LM		0.67 MM, 0.95 LM
	Konan *et al.* 2009 (16)[c]	0.89 MM, 0.94 LM	0.89 MM, 0.94 LM		0.86 MM, 0.95 LM
	Mirzatolooei *et al.* 2010 (23)[c,d]	0.63[d]	0.91[d]		0.40

Shrier, I., et al. Curr. Sports Med. Rep. 2010; 9(5): 284-289.

Meniscal Tears- Treatment

- Management depends on the type of tear, location and symptoms, age
  - Tear type:
    - Non-surgical (usual): small intrasubstance, vertical tears, degenerative tears
    - Surgical: large, complex tears, tears in communication with articular cartilage
  - Location:
    - Non-surgical: non-degenerative in the well vascularized, peripheral zones
    - Surgical: poorly vascularized, inner zones
  - Symptoms:
    - Non-surgical: Minor symptoms with well controlled pain, small effusions, no instability
    - Surgical: Major symptoms with locking (urgent referral), debilitating clicking
  - Age:
    - Non-surgical: Degenerative meniscal tears
    - Surgical: isolated meniscal tears in the young

JAMA Network Open

View Article

JAMA Netw Open. 2022 Jul; 5(7): e2220394.
Published online 2022 Jul 8. doi: 10.1001/jamanetworkopen.2022.20394

PMCID: PMC9270699
PMID: 35802374

Journal Article

Effect of Physical Therapy vs Arthroscopic Partial Meniscectomy in People With Degenerative Meniscal Tears

Five-Year Follow-up of the ESCAPE Randomized Clinical Trial

Julia C. A. Noorduyn, MSc,[1,2] Victor A. van de Graaf, MD, PhD,[1,3] Nienke W. Willigenburg, PhD,[1] Gwendolyne G. M. Scholten-Peeters, PhD,[2] Esther J. Kret, MSc,[1] Rogier A. van Dijk, MD, PhD,[4] Rachelle Buchbinder, MD, PhD,[5] Gillian A. Hawker, MD, PhD,[6] Michel W. Coppieters, PhD,[2,7] and Rudolf W. Poolman, MD, PhD[1,8], for the ESCAPE Research Group

Noorduyn JCA, van de Graaf VA, Willigenburg NW, Scholten-Peeters GGM, Kret EJ, van Dijk RA, Buchbinder R, Hawker GA, Coppieters MW, Poolman RW; ESCAPE Research Group. Effect of Physical Therapy vs Arthroscopic Partial Meniscectomy in People With Degenerative Meniscal Tears: Five-Year Follow-up of the ESCAPE Randomized Clinical Trial. JAMA Netw Open. 2022 Jul 1;5(7):e2220394. doi: 10.1001/jamanetworkopen.2022.20394. PMID: 35802374; PMCID: PMC9270699.

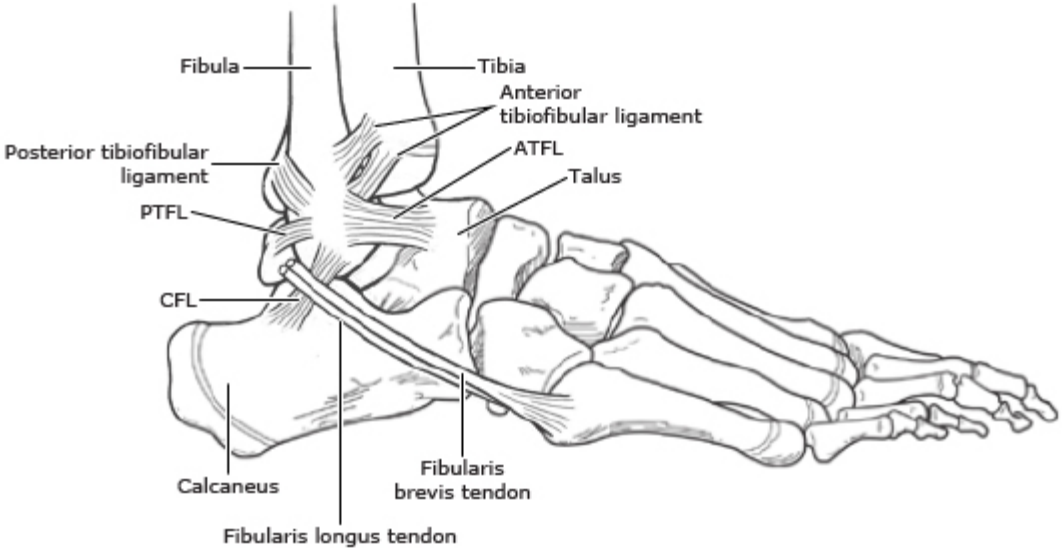
Meniscal Tears- Treatment

- Factors favoring conservative non-surgical therapies:
  - Symptoms develop over 24-48hrs after acute injury
  - Minimal swelling
  - Full range of motion
  - Pain with McMurray's testing only occurs with deep knee flexion
- Factors favoring surgery:
  - Severe twisting injury with activity cessation
  - Knee is locked
  - Pain with McMurray testing involving minimal knee flexion
  - Other associated intraarticular pathology (ie: ACL tear)
  - Minimal improvement in symptoms after 3-6 weeks conservative treatment

Frobell R, Cooper R, Morris H, Arendt E. Acute knee injuries. In: Clinical Sports Medicine, 4th ed, Brukner P, Khan K (Eds), McGraw-Hill, 2012. p.634.

Ankle Sprains

Ankle Anatomy

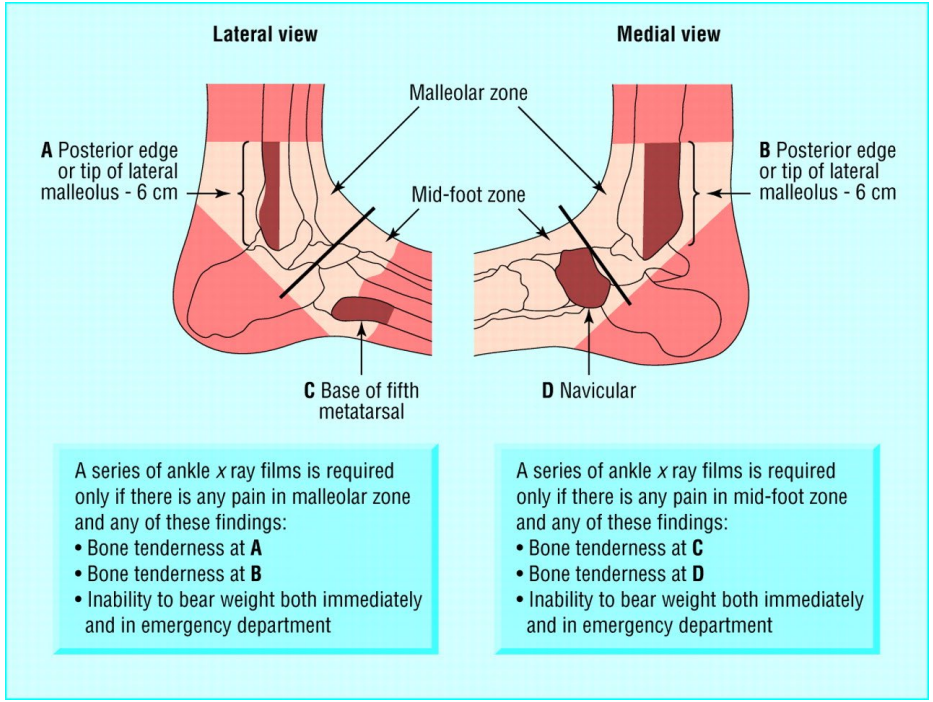


ATFL: anterior talofibular ligament; PTFL: posterior talofibular ligament; CFL: calcaneofibular ligament.
Graphic 72462 Version 6.0

Physical Examination- Ankle

- Complaint-Oriented Examination
- Joint Range of Motion
- Skin callous patterns
- Biomechanical Exam
  - Non-Weight bearing
  - Weight bearing
    - Symmetry
    - Antalgic?
- Shoe Examination
- Gait Analysis
  - Symmetry
  - Rapid Movement Screen

Ottawa Ankle Rules



https://www.researchgate.net/publication/266585955_Understanding_the_Role_of_the_Ottawa_Ankle_Rules_in_Physicians%27_Radiography_Decisions_A_Social_Judgment_Analysis_Approach

Physical Exam- Anterior Drawer Test

- Integrity of ATFL
- Slight Plantar flexion
  - Prone exam
- Anterior translation compared to contralateral side
- Optimum time 5th post injury day
- Pain may mask a positive test
- Sen 73-95%, Spec 84-97%
  - Combo of lateral ligament pain, hematoma, + ant drawer correct in 95%

Br J Sports Med 2002;36:83-84
Am J Orthop. 2011;40(4):192-197.

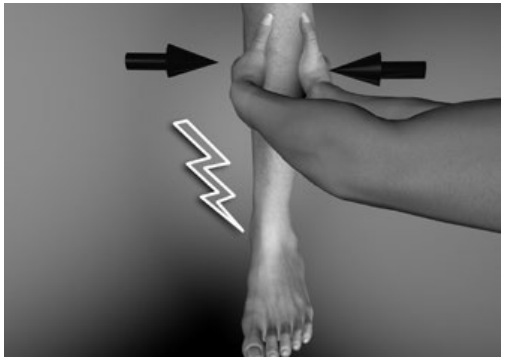
Physical Exam-Talar Tilt

- Tests CFL laterally
- Reverse Talar Tilt
  - Tests deltoid medially
- Check motion of talus/calcaneus relative to tib/fib
- Sens 67%/ Spec 75%

Extracted from Orthopedic Physical Examination Tests: An Evidence-Based Approach: "Medial Talar Tilt Stress Test": Hertel et al. Am J Orthop. 2011;40(4):192-197.

Special Tests—High Ankle

- External rotation test (Kleiger ‘s test):
  - Ankle at 90º, stabilizing the leg with one hand and forcefully externally rotating the foot on the ankle
  - If the affected side opens 15º greater than the normal side, the test is positive
  - Some also use pain with this test to suggest injury
  - Sens 20%/Spec 85%
- Squeeze Test:
  - Performed by compressing the tibia and fibula together on the mid leg
  - Sensitivity 30%
  - Specificity 93.5%
  - Pain is felt at the mortise joint of the ankle



Foot Ankle Int. 2011 Dec;32(12):1110-4
Am J Orthop. 2011;40(4):192-197.

PHYSICAL EXAMINATION: GAIT ANALYSIS

- Symmetry
  - Fixed problem
    - Varus knee
    - Cavus foot
    - Scoliosis
  - Dynamic problem
    - Limited dorsiflexion
    - Over-striding
    - Hip flexor ROM limitation
    - Under-activation of lateral hip musculature

Gait Analysis: Rapid Movement Screen

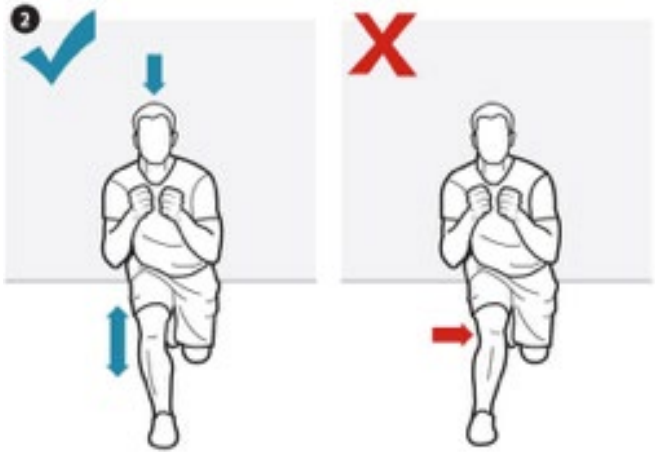
- Heel slide hip abduction
  - Side-lying position
  - Back of body and top Heel flat against wall, lower leg bent (balance)
  - Abduct leg keeping leg against wall
  - No lumbar side-bending during movement
- Grading
  - <15 repetitions poor
  - 15-30 average
  - >30 rock solid

Gait Analysis: Rapid Movement Screen

- Plank plus
  - Knees down plank position with hip, shoulder, and ear parallel to floor
  - Using yoga block, ball, etc place under abdomen as “block”
  - Drop chest between scapula to limit “rounding” of thoracic spine
  - “Draw in” maneuver for abdominals, but still having light contact with “block”
  - Without losing contact with “block”, straighten knees
  - Hold
- Grading
  - Screen:
    - <10 poor
    - 10-20 avg
    - >15 seconds without “jackhammer” or losing position solid

Gait Analysis: Rapid Movement Screen

- Single leg squat (screen single leg stance first for >10 seconds)
  - Stand on one leg in “stork stance”
  - Squat to ~30-45 degrees for 3 consecutive repetitions
- Grading
  - Poor:
    - (1) Loss of balance
    - (2) Inability to perform full motion
    - (3) Excess compensatory movement
  - Average
    - (1) Mild loss of balance
    - (2) Trendelenberg (compensated or uncompensated)
    - (3) Excessive rotation / knee valgus / pronation
  - Good
    - (1) Knee tracks over toe
    - (2) Any movements out of frontal plane are smooth and controlled



Gait Analysis: Rapid Movement Screen

- Split Squat
  - Toe to the wall
  - Back leg stepped
  - Back far enough to allow “right angles” when dropping to ground
  - 3 reps on each side
- Grading:
  - Poor:
    - (1)Loss of balance
    - (2) Pain in either knee at initiation of movement
    - (3) Front knee goes over toe
  - Average
    - (1) Able to drop back leg ~75% of distance to ground
    - (2) Mild LOB
    - (3) No excessive lumbar extension
  - Good
    - (1) Knee between ankle and toe comfortably
    - (2) Back knee hits ground and back up without pause
    - (3) All joints are at “right angles

Gait Analysis: Rapid Movement Screen

- Knee Up “1, 2, 3 /Hop Stick”
  - Standing on one foot, high knee twice to 90 degrees
  - “Stick” the landing
  - Performed 6 times (3 landings per foot)
- Grading
  - Poor:
    - (1) Fall/ uncontrolled LOB
    - (2) No consistency in landing point
    - (3) Knees don’t hit consistently to 90
  - Average:
    - (1) Moderate valgus / trendelenberg/pronation
    - (2) Stays within “square of the body”
    - (3) Controlled LOB on 2 or less items
  - Good:
    - (1) Smooth and controlled eccentric->concentric movement
    - (2) Light, quiet contact
    - (3) Soft, controlled landing with only mild deviation from midline

Ankle Sprains- Treatment

Acute management of soft tissue musculoskeletal injuries*

Intervention	Application and guidance
Protection and rest	▪ Unload and avoid movements in plane of injury. ▪ Avoid painful movements. ▪ Degree of protection (eg, wrap versus brace or crutches) and duration of rest depend on severity of injury.¶
Ice application	▪ Reduces pain and swelling. ▪ Apply for approximately 15 minutes, then remove for 45 minutes. May be applied hourly while awake. ▪ For significant injury, can apply for 48 to 72 hours. ▪ Use barrier (eg, thin, slightly damp towel) to avoid frostbite. ▪ Avoid in: • True cold allergy • Digits affected by Raynaud syndrome • Tissues affected by severe peripheral vascular disease • Open wounds • Areas with local infection
Compression	▪ Helps to reduce swelling, unload movements, and protect affected joints. ▪ Compression bandages and braces should not cause pain or impair blood flow.
Elevation	▪ Reduces swelling and pain. ▪ Raise injured tissue (usually the affected limb) above the level of the heart for upper extremity injury and above the pelvis for lower extremity injury. ▪ Generally maintained for 48 to 72 hours after any injury likely to cause significant swelling.

* Applies to injuries affecting muscles, tendons, ligaments, and some related tissues (eg, meniscus).

¶ Refer to UpToDate topics discussing specific injuries for guidance about appropriate protection.

Reference:

1. *Bleakley CM, Glasgow PD, Philips P, et al. Management of acute soft tissue injury using Protection Rest Ice Compression and Elevation: Recommendations from the Association of Chartered Physiotherapists in Sports and Exercise Medicine (ACPSM). 2011. Available at: https://www.physiosinsport.org/media/wysiwyg/ACPSM_Physio_Price_A4.pdf (Accessed on October 25, 2023).*

Ankle sprain functional rehabilitation program

Program is intended for uncomplicated grade I and II lateral ankle sprains and grade I medial (deltoid) ankle sprains.

Time required:

- Phase 1 (basic mobility): 6 to 9 minutes total (3× daily; day 2 to about day 5)
- Phase 2 (single-leg balance): 6 minutes total (3× daily; day 3 to conclusion)
- Phase 2 (strengthening): 8 minutes total (2× daily; day 3 to conclusion)
- Phase 3 (full mobility): 6 minutes total (2× daily; about day 5 to conclusion)
- Phase 4: Gradual return to full sport/heavy labor

Assuming Phase 3 begins when Phase 1 ends, this program requires approximately 20 minutes per day; times can be shortened if preferred by reducing activities from 3 to 2 times daily and/or reducing the number of sets per exercise. If the sprain is mild, symptoms resolve quickly, and healing is rapid, the program can be accelerated provided all phases are completed.

- *Following injury and before starting rehabilitation program, perform 24 to 48 hours of protection, rest, ice, compression, and elevation until swelling has subsided.*
- **Phase 1: Ankle motion to regain mobility** – Start 24 to 48 hours after injury; continue for 3 to 7 days total depending on severity of sprain. Can discontinue once ankle is pain free and exercises require only minimal effort.
  - Alphabet exercises: While sitting, use the big toe of the injured foot to trace the alphabet (upper- and lower-case) for 2 to 3 minutes. Perform 3 times per day.
- **Phase 2: Balance and early strengthening to regain effective ankle function** – Start exercises once able to stand 1-legged on injured ankle with only minimal or mild pain, typically 3 to 5 days after injury. Continue throughout functional rehabilitation program until return to full activity.
  - Single-leg balance drills – Stand on injured leg only for 1 minute, repeat once (2 sets total). Perform 3 times per day. Make this more difficult as able by adding 1 or more of the following: balance barefoot, close eyes, stand on soft surfaces (folded towel or thick carpet), add fore-to-aft or side-to-side sway. For maximum benefit, keep exercise challenging.
  - Strengthening: Perform twice daily while seated (wear footwear):
    - Place outside of the foot against a wall or other immobile, large object. Rotate foot out against the wall. Hold for 15 seconds, repeat twice (3 sets total).
    - Place inside of a foot against sturdy table leg or other immobile object. Rotate foot inward against the object. Hold for 15 seconds, repeat twice (3 sets total).
    - Place heel of non-injured foot on top of mid-foot of injured extremity. Keeping heel of injured foot on the ground, raise the forefoot (ie, dorsiflex ankle) against resistance provided by non-injured foot. Hold for 15 seconds, repeat twice (3 sets total).
    - Raise heel and push ball of injured foot against the floor (ie, plantarflex ankle). Hold for 15 seconds, repeat twice (3 sets total).
- **Phase 3: Ankle stretching to regain full motion** – Start 5 to 10 days after injury and continue throughout functional rehabilitation program until return to full activity.
  - Towel stretch of calf and Achilles tendon – Sit on floor with leg of the injured ankle extended. Loop a small towel around the ball of the foot. While maintaining a fully extended knee, pull the towel towards you, stretching the calf. Hold for 30 to 45 seconds, repeat 3 times (4 sets total). Between each stretch, take 30 seconds and point toes straight down (maximum plantarflexion), then down and in as much as tolerated (inversion), then up and out as much as tolerated (eversion), 10 seconds each. Perform the entire routine twice per day.
- **Phase 4: Gradual return to physically demanding work/recreational activity/sport**
  - Start with walking/running in single direction (road running, walking around office) – Can begin 7 to 10 days after injury; continue for 5 to 10 days (through day 12 to 20 after injury). Add more challenging movements (next step in Phase 4) when pain is resolved, ankle function feels normal, and you are comfortable placing greater demands on ankle.
  - Next, add some lateral movement and use slightly uneven surfaces (working at field sites, hiking on easy trails/low gradients, sport-specific drills) – Usually begins 12 to 20 days after injury; continue for 5 to 10 days (through day 17 to 30 after injury). We advise wearing a functional ankle brace.
  - Finally, add full lateral movement and high-function activities (field/court/rink sports, physical labor [eg, lifting equipment/work on uneven terrain/climbing ladders], hiking on uneven trails/steep gradients) – Usually begins 17 to 30 days after injury and continues indefinitely. We advise wearing a functional ankle brace.
- *Patient should continue program until ankle feels stable, pain is minimal or resolved, and overall function is at least 90% of uninjured, contralateral ankle.*

https://www.sportsmedreview.com/wp-content/uploads/2021/05/Ankle-sprain-rehab-protocol.pdf

Ankle Sprains- Treatment

- Factors favoring surgical referral:
  - Unstable fracture
  - Dislocation/subluxation
  - Syndesmotic injury*
  - Tendon rupture
  - Wound penetration
  - Refractory chronic ankle instability

Ankle Sprains- Treatment

- Consecutive patients with a confirmed rupture of at least one of the lateral ligaments of the ankle
- Evaluated at a median of 8 years (6 to 11)
- 370 patients were included
- **Fewer** patients allocated to operative treatment reported residual pain compared with those who had been allocated to functional treatment (16% versus 25%, RR 0.64, CI 0.41 to 1.0).
- **Fewer** surgically-treated patients reported symptoms of giving way (20% versus 32%, RR 0.62, CI 0.42 to 0.92) and recurrent sprains (22% versus 34%, RR 0.66, CI 0.45 to 0.94).
- Compared with functional treatment, operative treatment gives a better long-term outcome in terms of residual pain, recurrent sprains and stability.

Clinical Trial > J Bone Joint Surg Br. 2003 May;85(4):525-30. doi: 10.1302/0301-620x.85b4.13928.

Operative and functional treatment of rupture of the lateral ligament of the ankle. A randomised, prospective trial

A C M Pijnenburg [1], K Bogaard, R Krips, R K Marti, P M M Bossuyt, C N van Dijk

Affiliations + expand

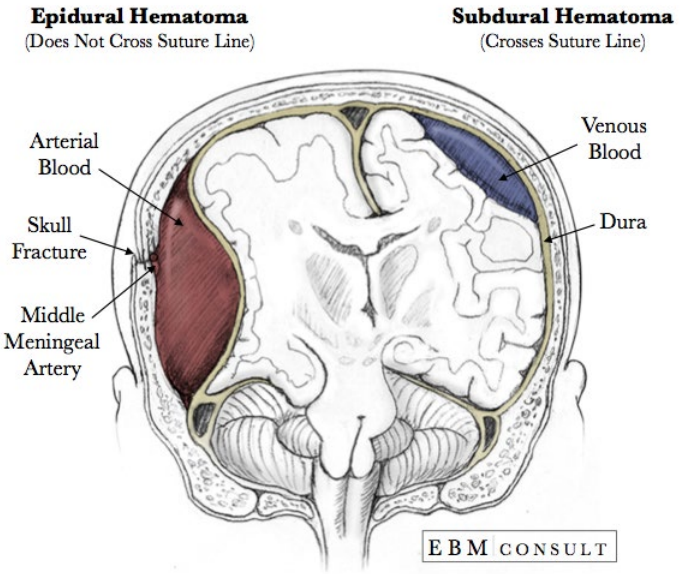
PMID: 12793557 DOI: 10.1302/0301-620x.85b4.13928

Given functional outcomes for non-severe injuries, relative costs, and operative risks, it is unlikely that surgery is justified in most patients with mild or moderate ankle sprains. Surgery may be reasonable in select patients with severe (grade III) sprains who are engaged in professional sports or other activities that impose repeated large stresses on the ankle joint. Referral to an orthopedic surgeon is appropriate for such patients.****

Pijnenburg AC, Bogaard K, Krips R, Marti RK, Bossuyt PM, van Dijk CN. Operative and functional treatment of rupture of the lateral ligament of the ankle. A randomised, prospective trial. J Bone Joint Surg Br. 2003 May;85(4):525-30. doi: 10.1302/0301-620x.85b4.13928. PMID: 12793557.

Concussion

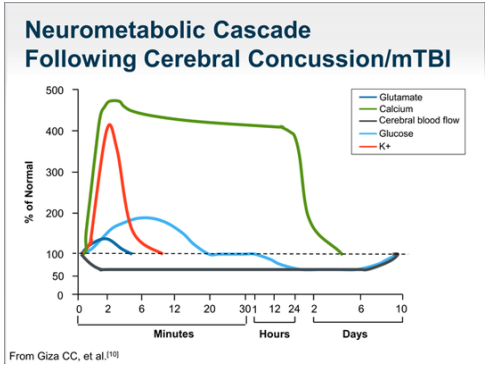
Brain Anatomy- Pathology



https://www.ebmconsult.com/articles/anatomy-epidural-subdural-hematoma

Concussion- Definition

- Sport-related concussion (SRC) is a traumatic brain injury caused by a direct blow to the head, neck or body resulting in an impulsive force being transmitted to the brain that occurs in sports and exercise-related activities.
    - →neurotransmitter and metabolic cascade, with possible axonal injury, blood flow change and inflammation affecting the brain.
- Symptoms and signs may present immediately, or evolve over minutes or hours, and commonly resolve within days, but may be prolonged.
- No abnormality is seen on standard structural neuroimaging studies (computed tomography or magnetic resonance imaging T1- and T2-weighted images)
    - research setting, abnormalities may be present on functional, blood flow or metabolic imaging studies.
- Sport-related concussion results in a range of clinical symptoms and signs that may or may not involve loss of consciousness. The clinical symptoms and signs of concussion cannot be explained solely by (but may occur concomitantly with) drug, alcohol, or medication use, other injuries (such as cervical injuries, peripheral vestibular dysfunction) or other comorbidities (such as psychological factors or coexisting medical conditions).



Concussion- History

NCAA-DoD CARE Consortium

- CARE data indicates: – Concussion risk is associated with:
  - (1) the magnitude of a single impact
  - (2) the individual's recent cumulative head impact exposure prior to injury; and/or
  - (3) individual concussion susceptibility thresholds
- 'Normal' recovery may take up to one month for the majority (80%) of participants
- Athletes with **3 or more** prior concussions experience:
  - Longer recovery times
  - Increased burden of post-concussive and psychological health symptoms years after injury in a variety of collegiate varsity sports

https://www.sbnation.com/nfl/2024/9/13/24243659/tua-tagovailoa-concussion-history-timeline-head-injury-dolphins

Concussion- Imaging

RED flags

- Worsening headache***
- Drowsiness or inability to be awakened
- Inability to recognize people or places
- Repeated vomiting***
- Unusual behavior or confusion or irritable
- Seizures
- Weakness or numbness in arms or legs
- Unsteadiness on their feet
- Slurred speech

Panel 1: **Canadian CT Head Rule**

CT Head Rule is only required for patients with minor head injuries with any one of the following:

High risk (for neurological intervention)

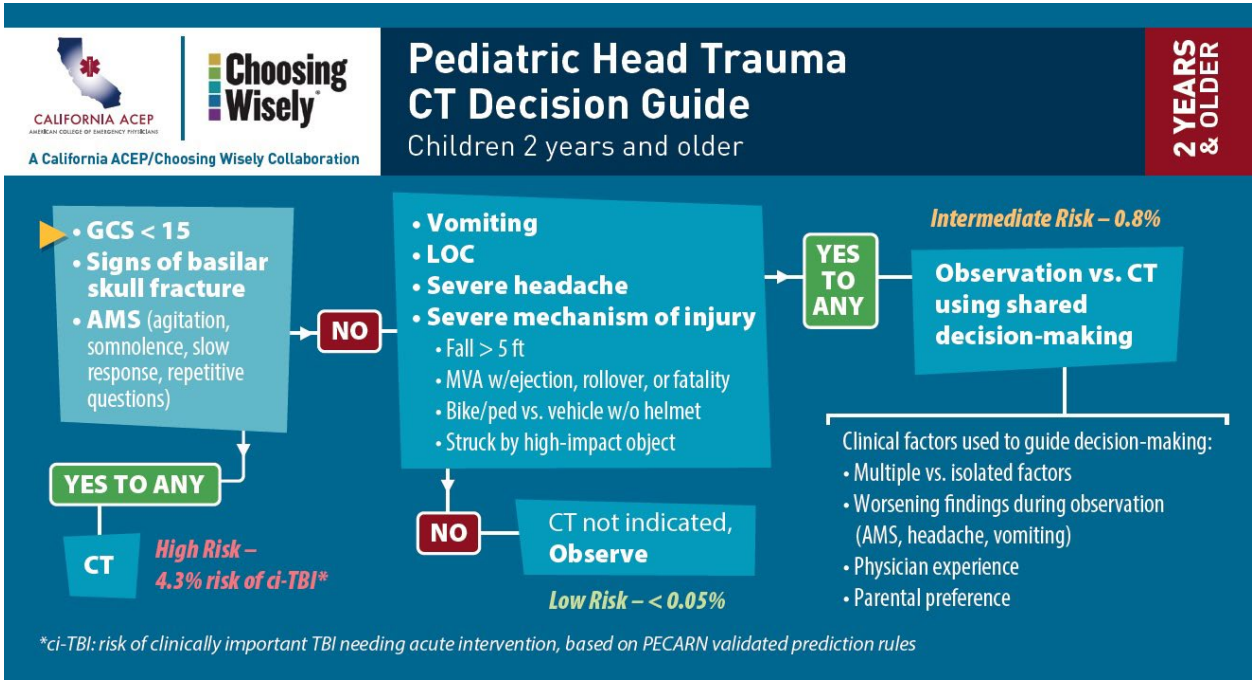
- GCS score <15 at 2 h after injury
- Suspected open or depressed skull fracture
- Any sign of basal skull fracture (haemotympanum, 'racoon' eyes, cerebrospinal fluid otorrhoea/rhinorrhoea, Battle's sign)
- Vomiting ⩾two episodes
- Age ⩾65 years

Medium risk (for brain injury on CT)

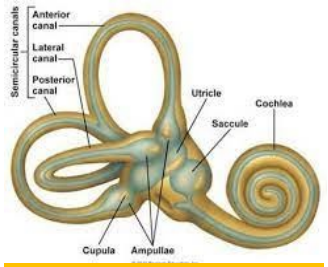
- Amnesia before impact >30 min
- Dangerous mechanism (pedestrian struck by motor vehicle, occupant ejected from motor vehicle, fall from height >3 feet or five stairs)

Minor head injury is defined as witnessed loss of consciousness, definite amnesia, or witnessed disorientation in a patients with a GCS score of 13–15.

Concussion- Imaging



Concussion- Subtypes

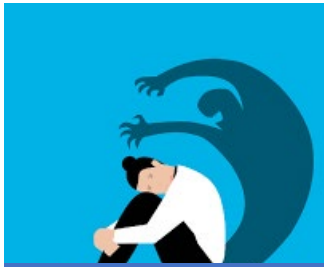


VESTIBULAR

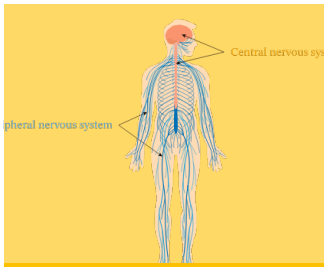
Ocular

Cognitive

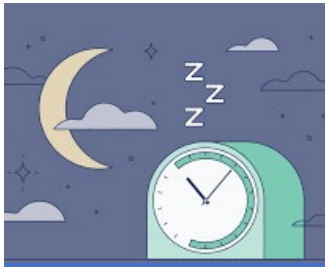
Migraine



Anxiety/Mood



Autonomic



Sleep

Cervical

Concussion- Predicting recovery

- Prolonged
  - High Risk: Depression
  - Not so high risk: ADHD, Learning Disability
  - Additional factors: unconsciousness, prolonged amnesia, more severe acute symptoms

McCrea M, Guskiewicz K, Randolph C, et al. Incidence, clinical course, and predictors of prolonged recovery time following sport-related concussion in high school and college athletes. J Int Neuropsychol Soc 2013;19:22–33.

Zemek R, Barrowman N, Freedman SB, et al. Clinical risk score for persistent postconcussion symptoms among children with acute concussion in the ED. JAMA 2016;315:1014–25.

Concussion- Treatment

Goals of treatment

- Minimize the duration of symptoms
- Return to activity (cognitive/physical) as soon as safely possible
- Avoid entirely the risk of second impact syndrome
- Minimize the rate of chronic post concussion syndrome
- ACTIVE RECOVERY*

Concussion- Treatment

Hallmarks of treatment

Recommend 24-48 hours of physical and cognitive rest followed by a gradual increase in activity, staying below symptom exacerbation threshold

Sub-symptom threshold exercise, started within 10 days, reduces post-concussion symptoms by 45%

Concussion- Treatment

Return to Learn

Table 4 Return to learn

Facilitate communication and transition back to school.

- Notify school personnel after injury to prepare for return to school.
  - Obtain consent for communication between medical and school teams.
- Designate point person to monitor the student's status related to academics, recovery and coping with injury, and communicate with medical team.
  - School health professional, guidance counsellor, administrator, athletic trainer.
- Develop plan for missed assignments and exams.
- Adjust schedule to accommodate reduced or modified attendance if needed.

Classroom adjustments

- Breaks as needed during school day.
- Reduce inclass assignments and homework.
- Allow increased time for completion of assignments and testing.
- Delay exams until student is adequately prepared and symptoms do not interfere with testing.
- Allow testing in a separate, distraction-free environment.
- Modify due dates or requirements for major projects.
- Provide preprinted notes or allow peer notetaker.
- Avoid high-risk or strenuous physical activity.

School environment adjustments

- Allow use of headphones/ear plugs to reduce noise sensitivity.
- Allow use of sunglasses/hat to reduce light sensitivity.
- Limit use of electronic screens or adjust screen settings, including font size, as needed.
- Allow student to leave class early to avoid crowded hallways.
- Avoid busy, crowded or noisy environments—music room, hallways, lunch room, vocational classes, assemblies.

Clinicians should individualise adjustments based on patient-specific symptoms, symptom severity, academic demands, as well as pre-existing conditions, such as mood disorder, learning disability or attention deficit/hyperactivity disorder.[87 88]

Athletes with complicated or prolonged recovery may require a multidisciplinary team with specific expertise across the scope of concussion management.

Make it SIMPLE

Concussion- Treatment

Return to Physical activity

IJSPT

CLINICAL COMMENTARY

PEDIATRIC SPORTS SPECIFIC RETURN TO PLAY GUIDELINES FOLLOWING CONCUSSION

Keith H. May, PT, DPT, SCS, ATC, CSCS[1]
David L. Marshall, MD[1]
Thomas G. Burns, PsyD, ABPP/CN[1]
David M. Popoli, MD[1]
John A. Polikandriotis, PhD, MBA, MPH, FACHE[1]

Step 1: Back to regular activities (such as school)
Athlete is back to their regular activities (such as school).

Step 2: Light aerobic activity
Begin with light aerobic exercise only to increase an athlete's heart rate. This means about 5 to 10 minutes on an exercise bike, walking, or light jogging. No weight lifting at this point.

Step 3: Moderate activity
Continue with activities to increase an athlete's heart rate with body or head movement. This includes moderate jogging, brief running, moderate-intensity stationary biking, moderate-intensity weightlifting (less time and/or less weight from their typical routine).

Step 4: Heavy, non-contact activity
Add heavy non-contact physical activity, such as sprinting/running, high-intensity stationary biking, regular weightlifting routine, non-contact sport-specific drills (in 3 planes of movement).

Step 5: Practice & full contact
Young athlete may return to practice and full contact (if appropriate for the sport) in controlled practice.

Step 6: Competition
Young athlete may return to competition.

May KH, Marshall DL, Burns TG, Popoli DM, Polikandriotis JA. Pediatric sports specific return to play guidelines following concussion. Int J Sports Phys Ther. 2014 Apr;9(2):242-55. PMID: 24790785; PMCID: PMC4004129.

Concussion- Treatment

Supplements

- Animal data:
  - Hopeful for:
    - B-vitamins, omega-3 fatty acids, vitamin D, progesterone, N-Methyl-D-asparte, exogenous ketones and dietary manipulations (aka ketogenic diet)
- No great human data

Updated research

CONSENSUS STATEMENT ON CONCUSSION IN SPORT: THE 6TH INTERNATIONAL CONFERENCE ON CONCUSSION IN SPORT–AMSTERDAM, OCTOBER 2022

Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport–Amsterdam, October 2022

Jon S Patricios ,[1] Kathryn J Schneider ,[2] Jiri Dvorak ,[3] Osman Hassan Ahmed ,[4,5] Cheri Blauwet ,[6,7] Robert C Cantu,[8,9] Gavin A Davis ,[10,11] Ruben J Echemendia ,[12,13] Michael Makdissi,[14,15] Michael McNamee,[16,17] Steven Broglio ,[18] Carolyn A Emery ,[2] Nina Feddermann-Demont,[19,20] Gordon Ward Fuller ,[21] Christopher C Giza,[22,23] Kevin M Guskiewicz,[24] Brian Hainline ,[25] Grant L Iverson ,[26,27] [illegible] David Maddocks,[30] Geoff Manley ,[31] [illegible] Margot Putukian ,[34] Haruhiko Sato ,[35] Markku T Tuominen,[36] Michael Turner ,[37,38] Keith Owen Yeates ,[39] Stanley A Herring,[40,41] Willem Meeuwisse[42]

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Accepted 2 June 2023

ABSTRACT

For over two decades, the Concussion in Sport Group has held meetings and developed five international statements on concussion in sport. This 6th statement summarises the processes and outcomes of the 6th International Conference on Concussion in Sport held in Amsterdam on 27–30 October 2022 and should be [illegible] that outlines the consensus process in detail and (2) 10 systematic reviews that informed the conference outcomes. Over 3½ years, author groups conducted systematic reviews of predetermined priority topics relevant to concussion in sport. The format of the conference, expert panel meetings and workshops to revise or develop new clinical assessment tools, as described in the methodology paper, evolved from previous consensus meetings with several new components. Apart from this consensus statement, the conference process yielded revised tools including the Concussion Recognition Tool-6 (CRT6) and Sport Concussion Assessment Tool-6 (SCAT6, Child SCAT6), as well as a new tool, the Sport Concussion Office Assessment Tool-6 (SCOAT6, Child SCOAT6). This consensus process also integrated new features including a focus on the para athlete, the athlete's perspective, concussion-specific medical ethics and matters related to both athlete retirement and the potential long-term effects of SRC, including neurodegenerative disease. This statement summarises evidence-informed principles of concussion prevention, assessment and management, and emphasises those areas requiring more research.

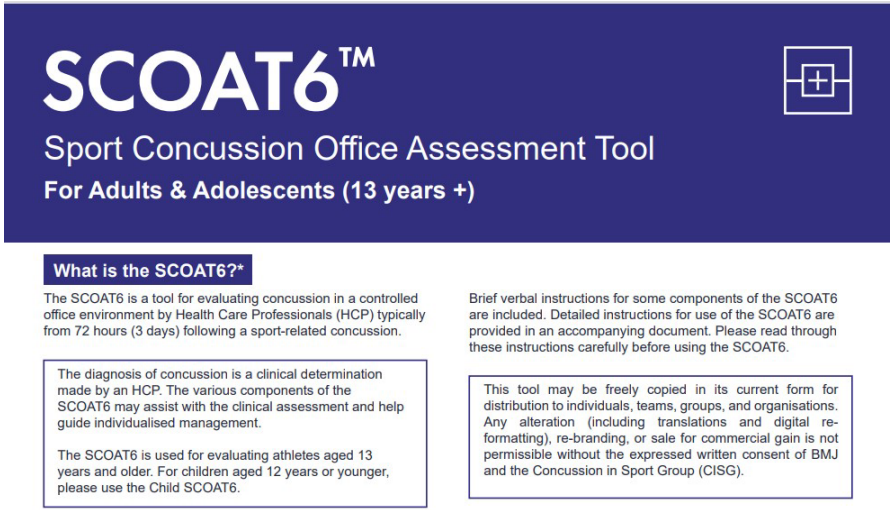
Check for updates

methodology. The purpose of this State[illegible]ent is to provide a summary of the evidence a[illegible] practice recommendations based on science a[illegible]d expert panel consensus recommendations at t[illegible] time of the conference. Additional outputs of the [illegible]consensus process include freely available evidenc[illegible]-informed tools to assist in the detection and ass[illegible]sment of [illegible]n Tool-6 (CRT6), Sport Concussion Assessment Tool-6 (SCAT6), Child SCAT6, Sport Concussion Office Assessment Tool-6 (SCOAT6) and Child SCOAT6. Apart from this Statement, in the interest of knowledge translation, the tools are free to distribute in their original formats.

This Statement is developed for the healthcare professional (HCP) involved in the care of athletes at risk of SRC or who have sustained a suspected SRC at any level of sport (ie, recreational to professional). The authors recognise that differences in geography, healthcare structure and culture are important considerations when implementing the principles presented. Thus, this Statement provides recommendations that can be adapted for different sport, clinical and cultural environments and is not meant to be used as a prescriptive guideline. We also recognise that the science of concussion continues to evolve, and the Amsterdam Statement reflects the state of the evidence at the time of the Consensus Conference and will need to be updated as new scientific information emerges. Also included are recommendations for future research where notable gaps in the literature have been identified. Although this Statement provides recommendations and is a summary of the consensus process, it should be read

SCOAT6

Symptom inventory
Thorough history (head injuries, Neuro, psych, meds)
Orthostatics
GAD7 and PHQ9
Cervical spine assessment
Cranial nerve and neuro assessment
Verbal cognitive tests
Balance (mBESS)
Timed Tandem Gait
VOMS or mVOMS



SCOAT6™

Sport Concussion Office Assessment Tool

For Adults & Adolescents (13 years +)

What is the SCOAT6?*

The SCOAT6 is a tool for evaluating concussion in a controlled office environment by Health Care Professionals (HCP) typically from 72 hours (3 days) following a sport-related concussion.

The diagnosis of concussion is a clinical determination made by an HCP. The various components of the SCOAT6 may assist with the clinical assessment and help guide individualised management.

The SCOAT6 is used for evaluating athletes aged 13 years and older. For children aged 12 years or younger, please use the Child SCOAT6.

Brief verbal instructions for some components of the SCOAT6 are included. Detailed instructions for use of the SCOAT6 are provided in an accompanying document. Please read through these instructions carefully before using the SCOAT6.

SCOAT6- Initial Evaluation

History of head injuries		
Date / Year	Description (mechanism, management, etc)	Management/recovery timeline
History of any neurological, psychological, psychiatric or learning disabilities		
Diagnosis	Year Diagnosed	Management Including Medication
○ **Migraine**		
○ **Chronic Headache**		
○ **Depression**		
○ **Anxiety**		
○ **Syncope**		
○ **Epilepsy/seizures**		
○ **ADHD**		
○ **Learning disorder/dyslexia**		
○ **Other**		

Cervical spine assessment

Palpation:

- Muscle Spasm
- Midline Tenderness
- Paravertebral Tenderness

Cervical AROM:

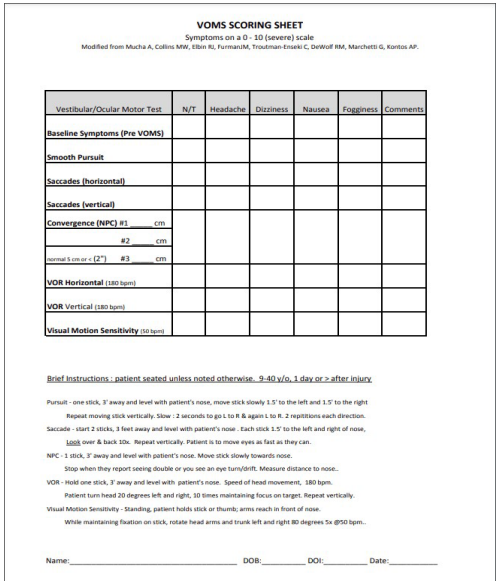
- Flexion (50-70 deg)
- Extension (60-85 deg)
- R Lateral Flexion (40-50 deg)
- L Lateral Flexion (40-50 deg)
- Right Rotation (60-75 deg)
- Left Rotation (60-75 deg)

****Cranial nerve and neuro assessment***

SCOAT6: 2-3 day follow up

Verbal cognitive tests

- Immediate Memory recall (10 word list)
- Digits Backwards
- Months in Reverse Order
- Recall Memory



VOMS SCORING SHEET

Symptoms on a 0 - 10 (severe) scale

Modified from Mucha A, Collins MW, Elbin RJ, FurmanJM, Troutman-Enseki C, DeWolf RM, Marchetti G, Kontos AP.

Vestibular/Ocular Motor Test	N/T	Headache	Dizziness	Nausea	Fogginess	Comments
Baseline Symptoms (Pre VOMS)						
Smooth Pursuit						
Saccades (horizontal)						
Saccades (vertical)						
Convergence (NPC) #1 ____ cm #2 ____ cm normal 5 cm or < (2") #3 ____ cm						
VOR Horizontal (180 bpm)						
VOR Vertical (180 bpm)						
Visual Motion Sensitivity (50 bpm)						

Brief Instructions : patient seated unless noted otherwise. 9-40 y/o, 1 day or > after injury

Pursuit - one stick, 3' away and level with patient's nose, move stick slowly 1.5' to the left and 1.5' to the right
Repeat moving stick vertically. Slow : 2 seconds to go L to R & again L to R. 2 repititions each direction.

Saccade - start 2 sticks, 3 feet away and level with patient's nose . Each stick 1.5' to the left and right of nose,
Look over & back 10x. Repeat vertically. Patient is to move eyes as fast as they can.

NPC - 1 stick, 3' away and level with patient's nose. Move stick slowly towards nose.
Stop when they report seeing double or you see an eye turn/drift. Measure distance to nose..

VOR - Hold one stick, 3' away and level with patient's nose. Speed of head movement, 180 bpm.
Patient turn head 20 degrees left and right, 10 times maintaining focus on target. Repeat vertically.

Visual Motion Sensitivity - Standing, patient holds stick or thumb; arms reach in front of nose.
While maintaining fixation on stick, rotate head arms and trunk left and right 80 degrees 5x @50 bpm..

Name:_____ DOB:_____ DOI:_____ Date:_____

Modified BESS

Position (held for 20sec)	Errors (#)	Description of errors
DL stance		
SL Stance		
Tandem Stance		
Total Errors		

Timed Tandem Gait

Time to Complete Tandem Gait Walking (seconds)				
Trial 1	Trial 2	Trial 3	Average time	Fastest Time

Orthostatics

Time	BP	Pulse	Symptoms experienced
Supine x 2min			
Standing x 1min			

VOMs Testing

SCOAT 6: 7-10 day follow up

- Symptom inventory / GAD7 & PHQ9
- Evaluation
- Discharge Criteria
  - Symptom resolution
  - Full return to learn
  - Full return to physical activity
- Referral
  - Cognitive and psychological difficulties
    - Referral to Counseling Services - Especially patients with Hx of mental health disorders and/or unresolved MH symptoms
  - Cervicogenic symptoms
    - Referral options: PT, AT, LMT, Acupuncture
  - Migraine and headache: Follow up with provider
  - Balance disturbances, vestibular signs and oculomotor manifestations
    - Referral to vestibular therapist. (Cooperative Performance & Rehab or other certified vestibular therapists)
  - Referral to Sports Medicine - serial/interval evaluation, rehabilitation and management

https://www.proactionsportsclinic.com/advice-exercises/concussion-exercises/

SCOAT6- Management plan

Return-to-Learn (RTL) Strategy

When the RTL strategy is implemented, it can begin following an initial period of relative rest (after 24-48 hrs), with an incremental increase in cognitive load (Steps 2 to 4). Progression through the strategy is symptom limited (i.e., no more than a mild exacerbation of current symptoms related to the current concussion) and its course may vary across individuals based on tolerance and symptom resolution. Further, while the RTL and return to physical activity strategies can occur in parallel, students should complete full RTL before unrestricted return to high-risk physical activity.

Step	Mental Activity	Activity at Each Step	Goal
1	Daily activities that do not result in more than a mild exacerbation of symptoms related to the current concussion.	Typical activities during the day (e.g., reading) while minimizing screen time. Start with 5 to 15 minutes at a time and increase gradually.	Gradual return to typical activities
2	School activities	Homework, reading, or other cognitive activities outside of the classroom.	Increase tolerance to cognitive work.
3	Return to school part time	Gradual introduction of schoolwork. May need to start with a partial school day or with access to rest breaks during class or throughout the day.	Increase academic activities.
4	Return to school full time	Gradually progress school activities until a full day can be tolerated without more than *mild* symptom exacerbation.	Return to full academic activities and catch up on missed work.

mild symptom exacerbation – is defined as an increase of no more than 2 points on a 0 - 10 point scale (with 0 representing no symptoms and 10 the worst symptoms imaginable) for less than an hour when compared with the baseline value reported prior to cognitive activity.

NOTE: Step 1 starts after an initial period of relative rest (24-48 hours following injury). Progression through the strategy should be slowed when there is more than a mild and brief symptom exacerbation.[1]

[1] Sport Concussion Office Assessment Tool 6 – SCOAT6. British Journal of Sports Medicine 2023

Return to Sport (RTS) Strategy

Return to sport participation after a concussion follows a graduated stepwise strategy which should occur in conjunction with return to learn and under the supervision of a qualified HCP. Following an initial period of relative rest (Step 1: approximately 24-48 hours), athletes should follow up with HCP (health care provider) to determine plan for progression through the strategy below.
Each step typically takes at least 24 hours. Clinicians and athletes can expect a minimum of 1 week to complete the full rehabilitation strategy, but typical unrestricted RTS can take up to one month post-concussion. The time frame for RTS may vary based on individual characteristics, necessitating an individualized approach to clinical management.

Step	Exercise Strategy	Activity at Each Step	Goal
1	Symptom-limited activity	Daily activities that do not exacerbate symptoms (e.g., walking)	Gradual reintroduction of work/school
2	Aerobic exercise 2A – Light (up to approx. 55% max HR) 2B – Moderate (up to approx. 70% max HR)	Stationary cycling or walking at slow to medium pace. May start light resistance training that does not result in more than mild and brief exacerbation of concussion symptoms.	Increase heart rate
3	Individual sport-specific exercise NOTE: if sport-specific exercise involves any risk of head impact, medical determination of readiness should occur prior to step 3.	Sport-specific training away from the team environment (e.g., running, change of direction and/or individual training drills away from the team environment). No activities at risk of head impact.	Add movement, change of direction.
	Steps 4-6 should begin after resolution of any symptoms, abnormalities in cognitive function, and any other clinical findings related to the current concussion, including with and after physical exertion.		
4	Non-contact training drills	Exercise to high intensity including more challenging training drills (e.g., passing drills, multiplayer training). Can integrate into team environment.	Resume usual intensity of exercise, coordination, and increased thinking.
5	Full contact practice.	Participate in normal training activities.	Restore confidence and assess functional skills by coaching staff.
6	Return to sport.	Normal game play.	

NOTE: *Mild and brief exacerbation of symptoms (i.e., an increase of no more than 2 points on a 0-10 point scale for less than an hour when compared with the baseline value reported prior to physical activity).
Athletes may begin Step 1 (i.e., symptom-limited activity) within 24 hours of injury, with progression through each subsequent step typically taking a minimum of 24 hours. If more than mild exacerbation of symptoms (i.e., more than 2 points on a 0-10 scale) occurs during Steps 1 -3, the athlete should stop and attempt to exercise the next day. If an athlete experiences concussion-related symptoms during Steps 4-6, they should return to Step 3 to establish full resolution of symptoms with exertion before engaging in at-risk activities.
You should receive evaluation and clearance from your health care provider (HCP) prior to starting steps 4 through 6.[1]

[1] Sport Concussion Office Assessment Tool 6 – SCOAT6. British Journal of Sports Medicine 2023

Return to Sport (RTS) Activity Log

Name or ID#: _____

Maximum Heart Rate = predicted maximal heart rate according to age (220-age).

Age predicted maximal HR 220 – (enter age) = enter mxHR	Mild Aerobic Exercise	Moderate Aerobic Exercise
55%	Training target HR =	
70%		Training target HR =

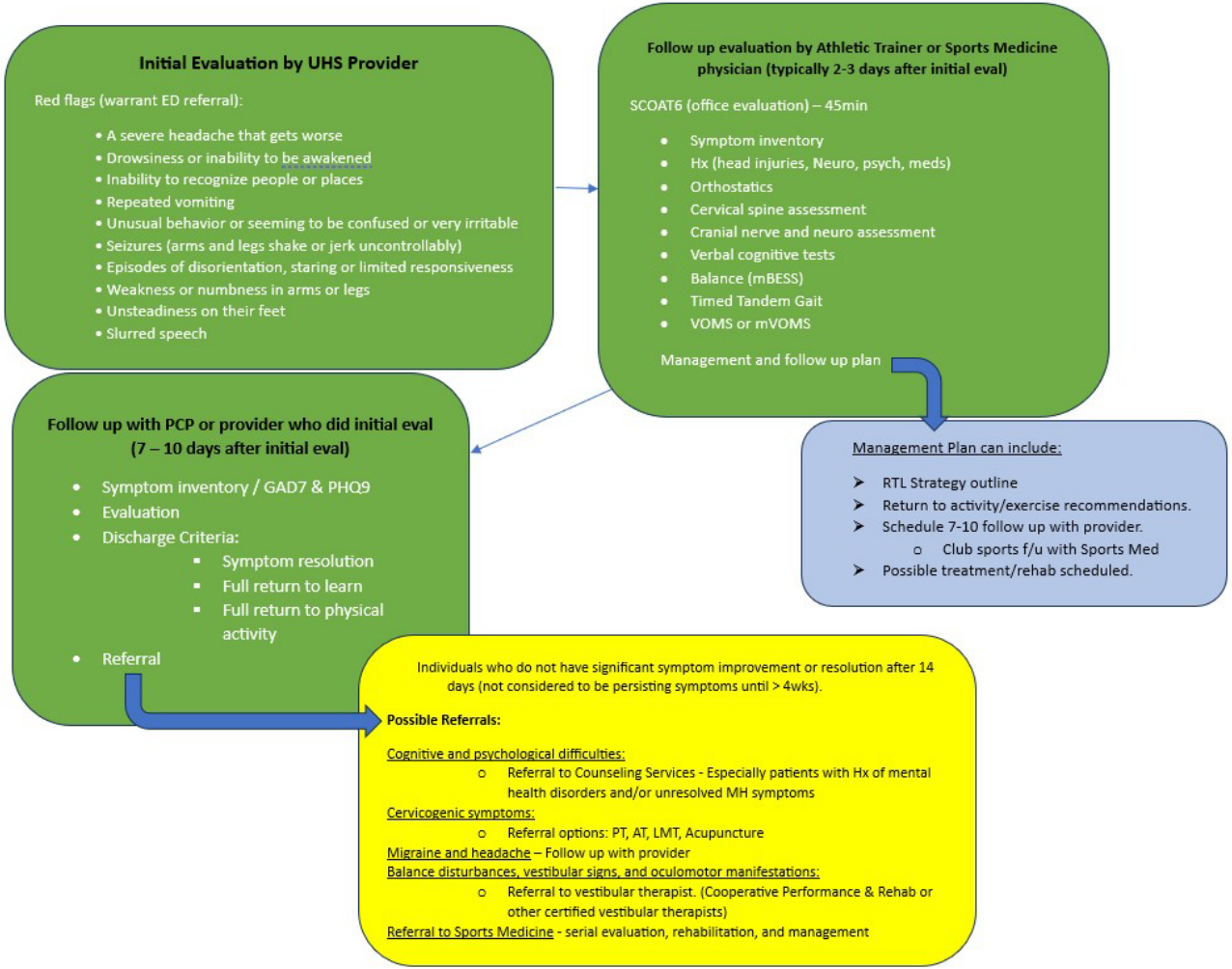
*Fill out Symptom Inventory prior to activity in Step 2 and Step 3

Date	Type of exercise *stationary cycling *walking	Length of activity (minutes)	Symptoms experienced	How long until resolution of symptoms

https://bjsm.bmj.com/content/57/11/651

Concussion Protocol

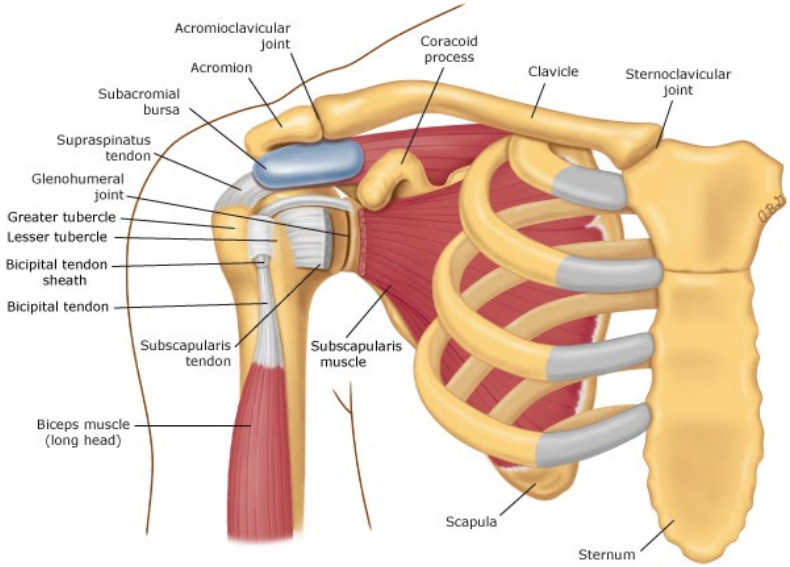
INITIAL EVALUATION	FOLLOW-UP EVAL	7-10 DAY FOLLOW UP	DISCHARGE OR SERIAL EVALUATION	REFERRAL
Provider at clinic	With AT or Sports Med MD 2 - 3 days after initial eval	With Initial eval provider	Criteria:	Dependent on symptoms


Initial Evaluation by UHS Provider
Red flags (warrant ED referral):
• A severe headache that gets worse
• Drowsiness or inability to be awakened
• Inability to recognize people or places
• Repeated vomiting
• Unusual behavior or seeming to be confused or very irritable
• Seizures (arms and legs shake or jerk uncontrollably)
• Episodes of disorientation, staring or limited responsiveness
• Weakness or numbness in arms or legs
• Unsteadiness on their feet
• Slurred speech
Follow up evaluation by Athletic Trainer or Sports Medicine physician (typically 2-3 days after initial eval)
SCOAT6 (office evaluation) – 45min
• Symptom inventory
• Hx (head injuries, Neuro, psych, meds)
• Orthostatics
• Cervical spine assessment
• Cranial nerve and neuro assessment
• Verbal cognitive tests
• Balance (mBESS)
• Timed Tandem Gait
• VOMS or mVOMS
Management and follow up plan
Management Plan can include:
➢ RTL Strategy outline
➢ Return to activity/exercise recommendations.
➢ Schedule 7-10 follow up with provider.
o Club sports f/u with Sports Med
➢ Possible treatment/rehab scheduled.
Follow up with PCP or provider who did initial eval (7 – 10 days after initial eval)
• Symptom inventory / GAD7 & PHQ9
• Evaluation
• Discharge Criteria:
▪ Symptom resolution
▪ Full return to learn
▪ Full return to physical activity
• Referral
Individuals who do not have significant symptom improvement or resolution after 14 days (not considered to be persisting symptoms until > 4wks).
Possible Referrals:
Cognitive and psychological difficulties:
o Referral to Counseling Services - Especially patients with Hx of mental health disorders and/or unresolved MH symptoms
Cervicogenic symptoms:
o Referral options: PT, AT, LMT, Acupuncture
Migraine and headache – Follow up with provider
Balance disturbances, vestibular signs, and oculomotor manifestations:
o Referral to vestibular therapist. (Cooperative Performance & Rehab or other certified vestibular therapists)
Referral to Sports Medicine - serial evaluation, rehabilitation, and management

Shoulder Impingement

Shoulder Anatomy

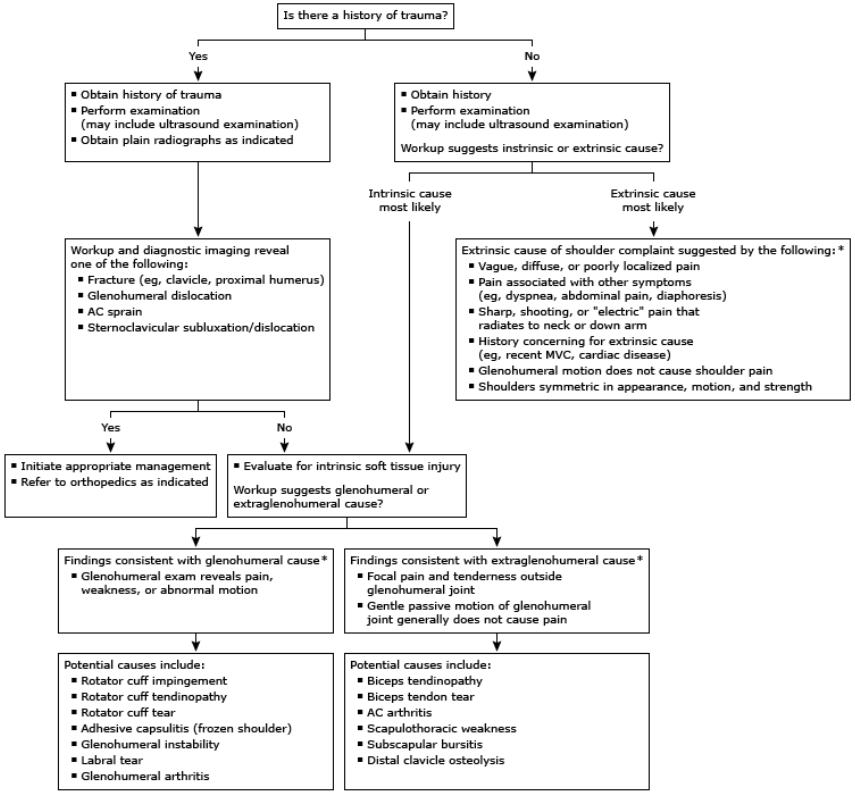
- 3 bones: clavicle, scapula, humerus
- 4 “joints” comprise the shoulder
  - Sternoclavicular
  - Acromioclavicular
  - Glenohumeral
  - Scapulothoracic (actually an articulation not joint)



Shoulder Pain

- Intrinsic Shoulder Causes
  - Bony/Articular
  - Neuropathic
  - Rotator Cuff/Bursal impingement
  - Labral
  - Bicep/Labral
- Referred pain:
  - Hand (i.e. carpal tunnel)
  - Neck (i.e. cervical radiculopathy)
  - Chest (i.e. cardiac pain, esp left shoulder)
  - Abdomen [i.e. diaphragmatic irritation (gall bladder to right scapula)]
- Timing:
  - At night (lying on side): RC
  - With overhead motions: impingement

Evaluation of adult with shoulder complaints



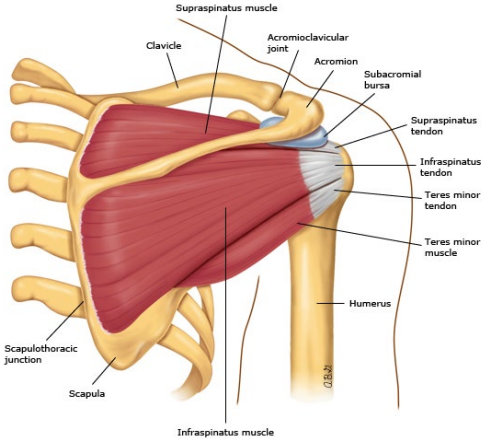
AC: acromioclavicular; MVC: motor vehicle collision.

* Refer to relevant UpToDate topic and tables on shoulder complaints in adults for more detailed information about specific conditions and the approach to diagnosis.

Shoulder Exam

- Palpation
  - Bony aspects
    - Clavicle/AC joint
    - Scapula
    - Proximal humerus
  - Biceps tendon (long and short heads)
  - Trapezius/paraspinals
- Range of Motion
  - Forward flexion:
    - 160 – 180°
  - Extension:
    - 40 - 60°
  - Abduction:
    - 180◦
  - Adduction:
    - 45 °
  - Internal rotation:
    - T6-7

- Inspection
  - Deformity
  - Asymmetry
  - Muscle atrophy
    - deltoid, supraspinatus, infraspinatus
  - Skin
  - Swelling
  - Ecchymosis
  - Venous distension



- Strength
  - EMG study by Kelly et al showed the best positioning to test each of the rotator cuff muscles
    - Supraspinatus:
      - "full can", pain with "empty can"
    - Infrapinatus:
      - External rotation from -45 degrees
    - Subscapularis
      - "Push Off" start with hand in small of back
- Special Tests: Impingement
  - Hawkins test
    - Arm passive abduction to 90*, forward flex 30* with thumbs pointing down, internal rotation
  - Neers Test
    - Arm to full forward elevation, pain 160-180*
    - Positive Neer test if pain relieved by injection

- Kai Y, Gotoh M, Madokoro K, Takei K, Murata S, Kanazawa T, Shibata H, Morihara T, Shiba N. Electromyographic study of rotator cuff muscle activity during full and empty can tests. Asia Pac J Sports Med Arthrosc Rehabil Technol. 2015 Jan 29;2(1):36-41. doi: 10.1016/j.asmart.2014.12.001. PMID: 29264238; PMCID: PMC5730645.
- Graphic 69995 Version 7.0 © 2024 UpToDate, Inc. and/or its affiliates

Shoulder Impingement/Rotator Cuff

- Definition
  - Symptoms and signs that result from compression of structures around the glenohumeral joint, including the rotator cuff tendons and subacromial bursa
- Predisposing factors
  - Patients with postural dysfunction, scapular dyskinesis, repetitive overhead sport activity, and occupations that require repetitive work at or above the shoulder are at greatest risk.

Shoulder Impingement/Rotator Cuff

- Total prevalence of partial (23%) and full thickness (49%) tears
  - In MRIs of asymptomatic patients >40yo, >10% have full thickness tears
  - ~50% of RTC tears progress with age
    - Over 40% of asymptomatic partial thickness defects progress to full thickness tears within three years
  - ~5% of RTC tears proceed to surgery (ie: most non-op management)

Thangarajah T, Lo IK. Optimal Management of Partial Thickness Rotator Cuff Tears: Clinical Considerations and Practical Management. Orthop Res Rev. 2022 Feb 26;14:59-70. doi: 10.2147/ORR.S348726. PMID: 35250316; PMCID: PMC8893150.

Shoulder Impingement/Rotator Cuff- Imaging

Imaging examinations for evaluation of shoulder pain

Imaging modality	Indications	Limitations
Radiography (also called plain film or X-ray)	Initial choice for all shoulder pathology Often the only modality needed for: ▪ Trauma ▪ Calcific tendonitis ▪ Osteoarthritis	Detection of: ▪ Bone contusion ▪ Subtle fractures ▪ Soft tissue pathology
CT	Preoperative evaluation of intra-articular fractures Post arthroplasty evaluation	Limited soft tissue evaluation Detection of bone marrow edema
MRI	Best modality for detecting soft tissue pathologies Evaluation of bone marrow	Lower sensitivity for evaluation of shoulder instability/labral tear compared with MR arthrography
Technetium 99m bone scan	Infection after arthroplasty (shoulder imaging) Suspected metastases (whole body imaging)	Lack of anatomic localization and resolution
Arthrography – Images are acquired after percutaneous injection of contrast into the joint		
Conventional radiography	Diagnosis and treatment of frozen shoulder (adhesive capsulitis)	Invasive
MR arthrography	Procedure of choice for evaluating shoulder instability/labral tear High suspicion of rotator cuff tear with normal MRI	Invasive
CT arthrography	Rotator cuff tear, when MRI is not available or is contraindicated Shoulder instability/labral tear when MR arthrography is not available or is contraindicated	Invasive Lower sensitivity for evaluation of shoulder instability/labral tear compared with MR arthrography
Ultrasonography	Evaluation of: ▪ Rotator cuff tendons ▪ Biceps tendon ▪ Subacromial space ▪ Muscle Interventional therapeutic procedures	Diagnostic performance not generalizable as the technique is highly operator dependent Modality is not widely available as on-site operator expertise is required Limited evaluation of very small or very large (>3 cm) tears and for partial thickness tears Limited evaluation of the labrum and bony structures

Intravenous contrast is not administered in shoulder CT or MRI for most clinical indications.

Soft tissues associated with the shoulder include the joint capsule, ligaments, tendons, bursa, muscles, and labrum.

CT: computed tomography; MRI: magnetic resonance imaging; MRA: magnetic resonance angiogram; MR: magnetic resonance.

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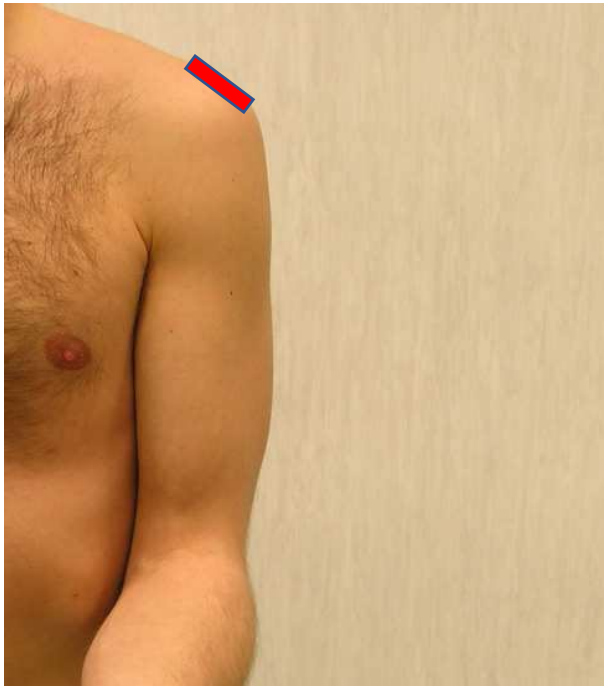
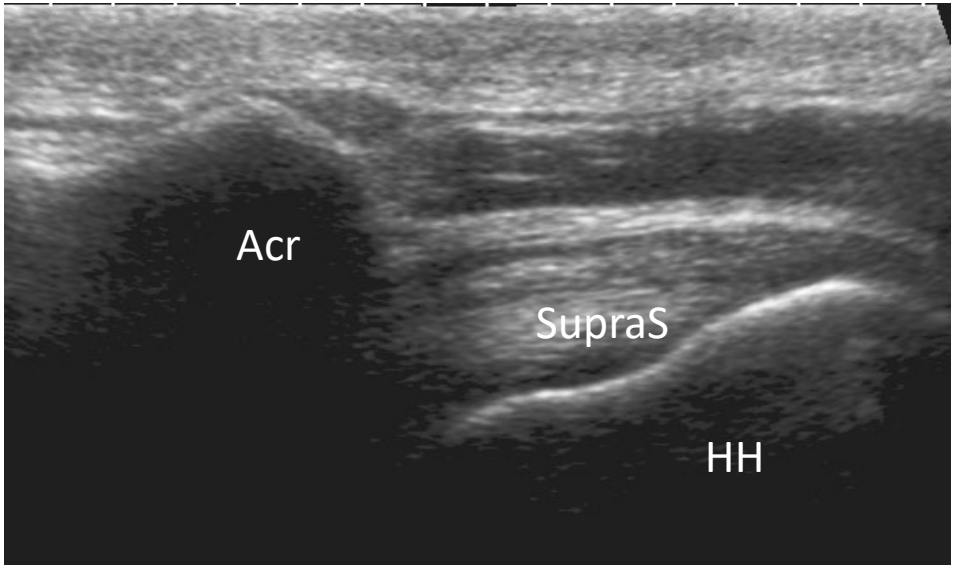
Shoulder Impingement/Rotator Cuff-Imaging

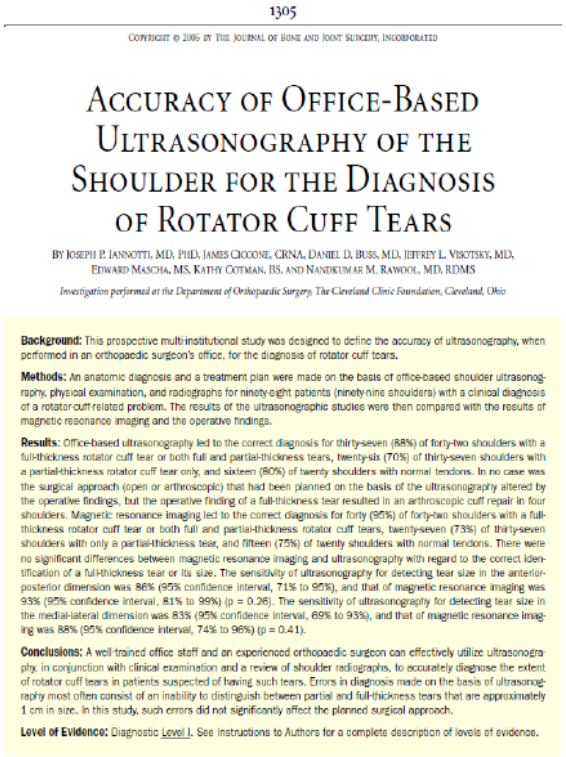




Jacobson, Jon. Fundamentals of Musculoskeletal Ultrasound. Ed 2. 2013
Bianchi, S. Ultrasound of the Musculoskeletal System. 2007.
Malanga, G. Atlas of Ultrasound-Guided Musculoskeletal Injections. 2014.
ESSR (European Society of Musculoskeletal

Shoulder Impingement/Rotator Cuff-Imaging

- Diagnosis
  - Office-based U/S
    - Correct diagnosis for 37/42 (88%) shoulders with a full-thickness RCT
    - 26/37 (70%) shoulders with a partial-thickness RCT only
    - 16/20 (80%) shoulders with normal tendons
  - MRI (95%, 73%, 75%) respectively



ACCURACY OF OFFICE-BASED ULTRASONOGRAPHY OF THE SHOULDER FOR THE DIAGNOSIS OF ROTATOR CUFF TEARS

BY JOSEPH P. IANNOTTI, MD, PHD, JAMES CICCONE, CRNA, DANIEL D. BUSS, MD, JEFFREY L. VISOTSKY, MD, EDWARD MASCHA, MS, KATHY COTMAN, BS, AND NANDKUMAR M. RAWOOL, MD, RDMS

Investigation performed at the Department of Orthopaedic Surgery, The Cleveland Clinic Foundation, Cleveland, Ohio

Background: This prospective multi-institutional study was designed to define the accuracy of ultrasonography, when performed in an orthopaedic surgeon's office, for the diagnosis of rotator cuff tears.

Methods: An anatomic diagnosis and a treatment plan were made on the basis of office-based shoulder ultrasonography, physical examination, and radiographs for ninety-eight patients (ninety-nine shoulders) with a clinical diagnosis of a rotator-cuff-related problem. The results of the ultrasonographic studies were then compared with the results of magnetic resonance imaging and the operative findings.

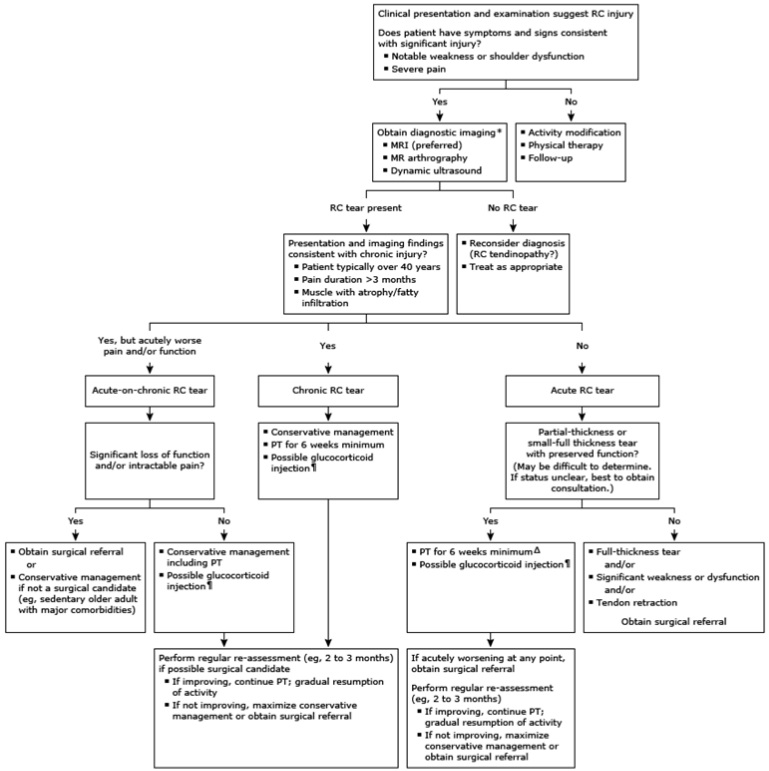
Results: Office-based ultrasonography led to the correct diagnosis for thirty-seven (88%) of forty-two shoulders with a full-thickness rotator cuff tear or both full and partial-thickness tears, twenty-six (70%) of thirty-seven shoulders with a partial-thickness rotator cuff tear only, and sixteen (80%) of twenty shoulders with normal tendons. In no case was the surgical approach (open or arthroscopic) that had been planned on the basis of the ultrasonography altered by the operative findings, but the operative finding of a full-thickness tear resulted in an arthroscopic cuff repair in four shoulders. Magnetic resonance imaging led to the correct diagnosis for forty (95%) of forty-two shoulders with a full-thickness rotator cuff tear or both full and partial-thickness rotator cuff tears, twenty-seven (73%) of thirty-seven shoulders with only a partial-thickness tear, and fifteen (75%) of twenty shoulders with normal tendons. There were no significant differences between magnetic resonance imaging and ultrasonography with regard to the correct identification of a full-thickness tear or its size. The sensitivity of ultrasonography for detecting tear size in the anterior-posterior dimension was 86% (95% confidence interval, 71% to 95%), and that of magnetic resonance imaging was 93% (95% confidence interval, 81% to 99%) ($p = 0.26$). The sensitivity of ultrasonography for detecting tear size in the medial-lateral dimension was 83% (95% confidence interval, 69% to 93%), and that of magnetic resonance imaging was 88% (95% confidence interval, 74% to 96%) ($p = 0.41$).

Conclusions: A well-trained office staff and an experienced orthopaedic surgeon can effectively utilize ultrasonography, in conjunction with clinical examination and a review of shoulder radiographs, to accurately diagnose the extent of rotator cuff tears in patients suspected of having such tears. Errors in diagnosis made on the basis of ultrasonography most often consist of an inability to distinguish between partial and full-thickness tears that are approximately 1 cm in size. In this study, such errors did not significantly affect the planned surgical approach.

Level of Evidence: Diagnostic Level I. See Instructions to Authors for a complete description of levels of evidence.

Iannotti JP, Ciccone J, Buss DD, Visotsky JL, Mascha E, Cotman K, Rawool NM. Accuracy of office-based ultrasonography of the shoulder for the diagnosis of rotator cuff tears. J Bone Joint Surg Am. 2005 Jun;87(6):1305-11. doi: 10.2106/JBJS.D.02100. PMID: 15930541.

Algorithm for management of rotator cuff tear



RC: rotator cuff; MRI: magnetic resonance imaging; MR: magnetic resonance; PT: physical therapy.

* It is best to determine which study to perform in consultation with the orthopedic surgeon to whom the patient is likely to be referred.

¶ Subacromial injection of glucocorticoid and analgesic can reduce symptoms and facilitate physical therapy. However, glucocorticoid increases the risk for failed surgical repair; therefore, such an injection should not be given if surgery may be performed within 3 months.

Δ It is reasonable to obtain immediate surgical referral for patients who are heavy laborers who rely on shoulder function for their livelihood or are professional or elite overhead athletes (eg, baseball pitcher, tennis player).

Shoulder Impingement/Rotator Cuff- Treatment

- Accuracy
  - Guided injections (shoulder) tend to be more accurate in placement as compared to anatomic-guided (“blind”) injections

Subacromial corticosteroid injections

Konrad I. Gruson, MD, David E. Ruchelsman, MD, and Joseph D. Zuckerman, MD, New York, NY

The use of subacromial injections to treat shoulder pain has remained one of the most common procedures for the practicing orthopedist, rheumatologist, and general practitioner. Despite this, many prospective studies have questioned the efficacy of corticosteroid injections compared with nonsteroidal anti-inflammatory drugs or injections of local anesthetics alone, or both, when used for the treatment of symptomatic rotator cuff disease. Accurate diagnosis of the etiology of a patient's shoulder pain and proper injection technique are important in achieving satisfactory clinical outcomes. Both extrinsic as well as intrinsic etiologies for rotator cuff disease should be considered and must be elucidated with appropriate physical examination techniques. Although subacromial injections appear straightforward, more recent cadaveric, radiographic, and clinical studies have demonstrated variable accuracy rates using the two common techniques. In addition, absolute sterile technique must be used because infections of the subacromial space after injections, although uncommon, have generally led to debilitating conditions. This article reviews the etiology and pathophysiology of rotator cuff disease and the indications and techniques for subacromial corticosteroid injections. (J Shoulder Elbow Surg 2008;17:118S-130S.)

Shoulder pain due to rotator cuff pathology accounts for many annual patient visits to orthopedists and rheumatologists, as well as general practitioners. An understanding of the complex shoulder anatomy, familiarity with a broad differential that may be responsible for the symptoms, and competence with shoulder physical examination are requisite for establishing a definitive diagnosis. Cervical spine pathology must be ruled out during history taking and physical examination. Gorski and Schwartz[17] reported a series of patients with subjective complaints of neck pain, positive impingement signs, and radiographic findings of a greater tuberosity pseudocyst or subacromial sclerosis. These patients responded to subacromial lidocaine and corticosteroid injections and behavior modification; the authors recommended adding shoulder impingement to the differential diagnosis of chronic neck pain.

Our comprehension of the complex etiology and pathophysiology of rotator cuff disease continues to evolve through contributions from basic science research and clinical data. Although subacromial impingement commonly affects the shoulder,[7] it is important to recognize that outlet impingement implicitly establishes both a diagnosis of rotator cuff disease as well as the pathomechanics (ie, subacromial mechanical abutment) for the acquisition and progression of bursal-sided cuff pathology. In addition to extrinsic factors, intrinsic degenerative tendinopathy[7] may be important in the etiology of the development of clinically significant rotator cuff disease and impingement; partial tears may allow subtle proximal humeral head migration, which may result in subacromial impingement and, ultimately, full-thickness cuff tears. Other causes for rotator cuff disease must also be considered, such as internal impingement,[34] which may culminate in articular-sided cuff pathology or labral lesions. This disorder is seen more often in younger, high-performance overhead athletes who subject their shoulders to repetitive and extreme external rotation. This patient population is less likely to respond to subacromial corticosteroid injections.

Compression of the supraspinatus tendon against the undersurface of the anterior acromion, as originally described by Neer, results in a spectrum of bursal-sided rotator cuff pathology and may manifest as subacromial bursitis, acute[18,44] and chronic[36] tendonitis, and attritional degenerative tears.[7] Neer described outlet impingement as occurring in a continuum of stages: early macroscopic changes may be limited to local edema and hemorrhage (stage 1); with chronic repetitive impingement, subacromial bursal fibrosis (stage 2) is followed by irreversible tendon disruption (stage 3; partial/complete tears).[33] Zlatkin et al[45] proposed a staging system of subacromial impingement syndrome based on progressive pathologic changes in the rotator cuff observed on magnetic resonance imaging (MRI; Table I).

From Department of Orthopaedic Surgery, New York University Hospital for Joint Diseases.

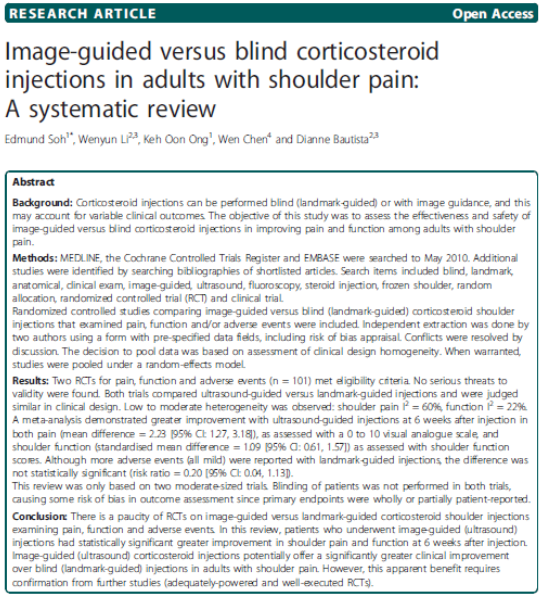
Reprint requests: Joseph D. Zuckerman, MD, NYU Hospital for Joint Diseases, Department of Orthopaedic Surgery, 301 E 17th St, Ste 1402, New York, NY 10003 (E-mail: Joseph.Zuckerman@nyumc.org).

1058-2746/2008/$34.00
doi:10.1016/j.jse.2007.07.009

Konrad I. Gruson, David E. Ruchelsman, Joseph D. Zuckerman, Subacromial corticosteroid injections, Journal of Shoulder and Elbow Surgery, Volume 17, Issue 1, Supplement, January–February 2008, Pages S118-S130.

Shoulder Impingement/Rotator Cuff- Treatment

- Efficacy
  - 2 RCTs pooled data
  - Improved pain and function at 6 weeks post-injection guided vs anatomic-guided



RESEARCH ARTICLE Open Access

Image-guided versus blind corticosteroid injections in adults with shoulder pain: A systematic review

Edmund Soh[1*], Wenyun Li[2,3], Keh Oon Ong[1], Wen Chen[4] and Dianne Bautista[2,3]

Abstract

Background: Corticosteroid injections can be performed blind (landmark-guided) or with image guidance, and this may account for variable clinical outcomes. The objective of this study was to assess the effectiveness and safety of image-guided versus blind corticosteroid injections in improving pain and function among adults with shoulder pain.

Methods: MEDLINE, the Cochrane Controlled Trials Register and EMBASE were searched to May 2010. Additional studies were identified by searching bibliographies of shortlisted articles. Search items included blind, landmark, anatomical, clinical exam, image-guided, ultrasound, fluoroscopy, steroid injection, frozen shoulder, random allocation, randomized controlled trial (RCT) and clinical trial.
Randomized controlled studies comparing image-guided versus blind (landmark-guided) corticosteroid shoulder injections that examined pain, function and/or adverse events were included. Independent extraction was done by two authors using a form with pre-specified data fields, including risk of bias appraisal. Conflicts were resolved by discussion. The decision to pool data was based on assessment of clinical design homogeneity. When warranted, studies were pooled under a random-effects model.

Results: Two RCTs for pain, function and adverse events (n = 101) met eligibility criteria. No serious threats to validity were found. Both trials compared ultrasound-guided versus landmark-guided injections and were judged similar in clinical design. Low to moderate heterogeneity was observed: shoulder pain $I^2 = 60\%$, function $I^2 = 22\%$. A meta-analysis demonstrated greater improvement with ultrasound-guided injections at 6 weeks after injection in both pain (mean difference = 2.23 [95% CI: 1.27, 3.18]), as assessed with a 0 to 10 visual analogue scale, and shoulder function (standardised mean difference = 1.09 [95% CI: 0.61, 1.57]) as assessed with shoulder function scores. Although more adverse events (all mild) were reported with landmark-guided injections, the difference was not statistically significant (risk ratio = 0.20 [95% CI: 0.04, 1.13]).
This review was only based on two moderate-sized trials. Blinding of patients was not performed in both trials, causing some risk of bias in outcome assessment since primary endpoints were wholly or partially patient-reported.

Conclusion: There is a paucity of RCTs on image-guided versus landmark-guided corticosteroid shoulder injections examining pain, function and adverse events. In this review, patients who underwent image-guided (ultrasound) injections had statistically significant greater improvement in shoulder pain and function at 6 weeks after injection. Image-guided (ultrasound) corticosteroid injections potentially offer a significantly greater clinical improvement over blind (landmark-guided) injections in adults with shoulder pain. However, this apparent benefit requires confirmation from further studies (adequately-powered and well-executed RCTs).

Soh E, Li W, Ong KO, Chen W, Bautista D. Image-guided versus blind corticosteroid injections in adults with shoulder pain: a systematic review. BMC Musculoskelet Disord. 2011 Jun 25;12:137.

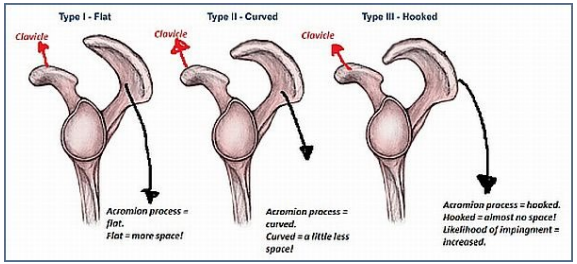
Shoulder Impingement/Rotator Cuff- Treatment

- Glenohumeral Joint
  - USGIs were **more efficacious** than Landmark Guided Injections
- Acromioclavicular Joint
  - *No difference in efficacy* was found between USGIs and LMGIs
- Subacromial Space
  - USGIs were **more efficacious** than Landmark Guided Injections
- Biceps Tendon
  - USGIs were **more efficacious** than Landmark Guided Injections
- Hand and Wrist Joints
  - USGIs were **more efficacious** than Landmark Guided Injections

Eldra W. Daniels, et al. Existing Evidence on Ultrasound-Guided Injections in Sports Medicine. The Orthopaedic Journal of Sports Medicine. 2018; 6(2): 1-7.

Shoulder Impingement/Rotator Cuff-Treatment

- Factors favoring surgical referral:
  - Anatomical abnormality with refractory pain (ie: acromial type)
  - Acute, full-thickness, traumatic tear (especially in younger population)
  - Sudden or severe weakness in patient with pre-existing, partial-thickness tear
  - Failure to improve after 3 months of physical therapy and/or symptoms or function worsen during the initial 6 weeks of physical therapy
  - Specific populations
    - Heavy laborer with partial tear
    - Elite/professional overhead athlete



https://www.physio-pedia.com/Subacromial_Pain_Syndrome

Tennis Elbow

Elbow Anatomy

- Overuse injury involving the proximal

tendons of the extensor carpi radialis brevis

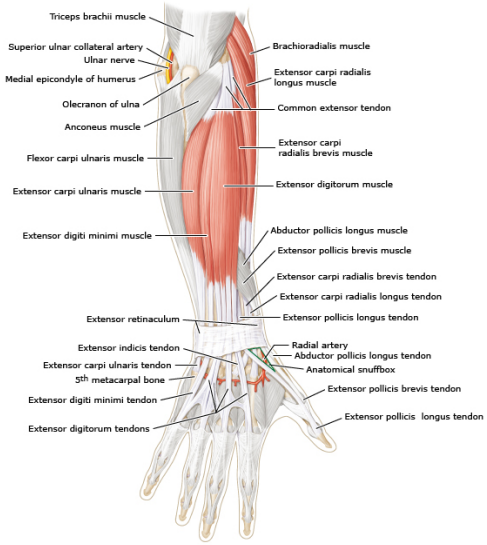
(felt at tip of lateral epicondyle)

and occasionally the extensor digitorum communis muscle

(felt just posterior and distal to tip of lateral epicondyle)

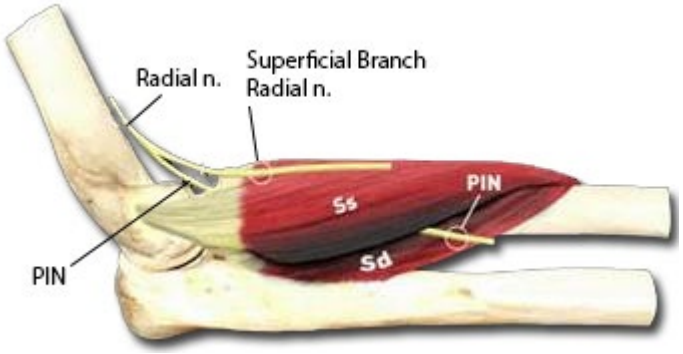
constitutes lateral elbow tendinopathy

- Posterior interosseus nerve (PIN) enters the supinator just distal to the radial head



Lateral Epicondylitis

- Differential Diagnosis
  - Loose bodies
  - OCD (osteochondral defect)
  - Radial head fracture
  - Valgus extension overload
  - Inflammatory arthritis
  - Radial Tunnel Syndrome (present in 5%)
  - Thoracic Outlet syndrome
  - Cervical radiculopathy



https://www.orthobullets.com/hand/6024/radial-tunnel-syndrome

Lateral Epicondylitis- Physical Exam

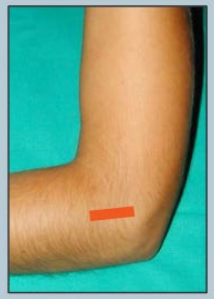
- Inspection
- Palpation
  - Point tenderness at ECRB insertion at lateral epicondyle
- Neurovascular exam
- Range of motion: flexion, extension, supination, pronation
- Varus/valgus stress test; UCL/RCL
- Special tests (provocative tests)
  - Resisted wrist extension with elbow fully extended and forearm pronated
  - Resisted extension of the long finger (Maudsley's test)
  - Maximal flexion of the wrist
  - Resisted dorsal flexion (Cozen's test); Sens 91%
  - Grip strength difference between elbow flexion/extension; Sens 78-83%, Spec 80-90%

Karanasios S, Korakakis V, Moutzouri M, Drakonaki E, Koci K, Pantazopoulou V, Tsepis E, Gioftsos G. Diagnostic accuracy of examination tests for lateral elbow tendinopathy (LET) - A systematic review. J Hand Ther. 2022 Oct-Dec;35(4):541-551. doi: 10.1016/j.jht.2021.02.002. Epub 2021 Feb 27. PMID: 33814224.

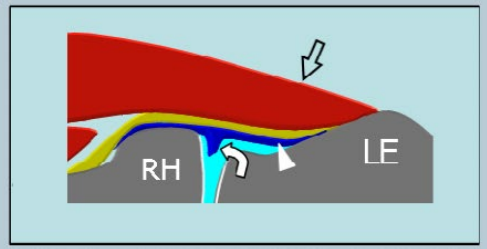
Lateral Epicondylitis- Imaging

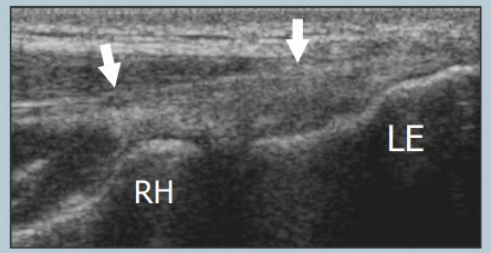
5 LATERAL ELBOW: common extensor tendon

The lateral aspect of the elbow is examined with both elbows in extension, thumbs up, palms of hands together or with the elbow in flexion. The common extensor tendon is visualized on its long-axis using coronal planes with the cranial edge of the probe placed on the lateral epicondyle.



Short-axis planes should be also obtained over the tendon insertion. In normal conditions, the lateral ulnar collateral ligament cannot be separated from the overlying extensor tendon due to a similar fibrillar echotexture.





Legend: arrowhead; lateral ulnar collateral ligament; curved arrow, lateral synovial fringe; LE, lateral epicondyle; RH, radial head; straight arrows, common extensor tendon

https://essr.org/content-essr/uploads/2016/10/elbow.pdf

Basic rehabilitation program for lateral epicondylalgia (tennis elbow)

Phase I – Acute phase (two weeks to one month; progress to next phase as soon as Phase II exercises can be tolerated)
Goals: 1. Control pain. 2. Reduce inflammation.
Protection – Avoid activity that reproduces pain.
Ice – Apply cold pack to the affected area for 10 to 15 minutes, two to three times per day and after exercise as needed.
Bracing – Counterforce brace or elbow compression sleeve may be used to improve ability to perform work duties and daily activities.
Therapeutic exercise (okay to continue with pain ≤3/10): 1. Wrist extensor stretching – Perform five sets of a 20-second stretch three times per day (stretch only until slight discomfort felt). 2. Active range of motion – Move wrist through full range of extension and flexion. Perform three sets of 15 repetitions three times per day. 3. Gentle strengthening as pain allows: a. Wrist extension – Perform three sets of 15 repetitions with light weight (0.5 to 1 kg; one to two pounds). b. Forearm supination-pronation – While holding a hammer or the bottom of a hand weight, perform three sets of 15 repetitions. Use light weight (0.5 to 1 kg; one to two pounds). c. Grip strength – Grip and release putty, a stress ball, or a foam block. Perform 30 repetitions three times per day.
Phase II – Chronic phase (generally lasts more than one month)
Goals: 1. Improve strength. 2. Promote healing.
Protection – Avoid activity that causes pain >3/10. Avoid sporting activity that reproduces symptoms. Strengthening should cause only mild pain and soreness (pain ≤3/10).
Ice – May use if needed. Apply cold pack 10 to 15 minutes or perform ice massage three to five minutes. Perform up to three times per day.
Bracing/equipment modification – May use counterforce brace if necessary for performance of work duties or daily activities.
Tennis athletes – Reduce string tension, confirm proper grip size and cushion, use string dampener.
Occupational workers – Use cushioned grips.
Therapeutic exercises (may perform with pain <3/10): 1. Wrist extensor stretching – Perform five sets of 20-second stretch three times per day. 2. Wrist extensor eccentric strength – Perform using an elastic band or dumbbell. Complete three sets of 15 repetitions. 3. Flexbar eccentric strength – Perform three sets of 15 repetitions. 4. Cross-friction massage over the common extensor origin at the lateral epicondyle. 5. Forearm supination-pronation eccentric strength – Holding a hammer or light dumbbell, perform three sets of 15 repetitions. 6. Shoulder external rotation with retraction – Using an elastic band, perform three sets of 15 repetitions. 7. Shoulder external rotation – Using an elastic band, perform three sets of 15 repetitions. 8. Elastic band backhands (tennis athletes) – Using an elastic band, perform backhand motion. Complete three sets of 15 repetitions. Concentrate on decelerating through the shoulder blade. 9. Serve simulations (tennis athletes) – Perform three sets of 15 repetitions holding a light weight (0.5 to 1 kg; one to two pounds).
Phase III – Return to activity
1. Full strength without pain during resisted wrist extension and during resisted forearm pronation and supination with the elbow in extension. 2. Full range of elbow and wrist motion without pain. 3. Pain-free forceful grip. 4. Pain-free tennis strokes with reduced forearm pronation on forehand and serves and reduced wrist extension on backhand. 5. Continue Phase II exercises twice weekly.

Lateral Epicondylitis- Treatment

- Pro-inflammatory options
  - U/S guided partial tenotomy
  - Prolotherapy
  - Topical nitric oxide
  - ECSW
  - Acupuncture
  - PRP
  - Botox

Topical Nitric Oxide Application in the Treatment of Chronic Extensor Tendinosis at the Elbow

A Randomized, Double-Blinded, Placebo-Controlled Clinical Trial

Justin A. Paoloni, MBBS, Richard C. Appleyard, PhD, Janis Nelson, MClinPharm, and George A. C. Murrell,* MBBS, DPhil

From the Orthopaedic Research Institute, St. George Hospital Campus, University of New South Wales, Sydney, New South Wales, Australia

Background: Extensor tendinosis ("tennis elbow") is a degenerative overuse tendinopathy of the wrist extensors at their attachment to the lateral humeral epicondyle. No treatment has been universally successful. Topical application of nitric oxide has been used effectively to treat fractures and cutaneous wounds in animal models, presumably by stimulation of collagen synthesis in fibroblasts.
Purpose: To determine whether topical nitric oxide can improve outcome of patients with extensor tendinosis.
Study Design: Prospective, randomized, double-blinded clinical trial.
Methods: Eighty-six patients with extensor tendinosis were randomized into two equal groups; both were instructed to perform a standard tendon rehabilitation program. One group received an active glyceryl trinitrate transdermal patch, and the other group received a placebo patch.
Results: Patients in the glyceryl trinitrate group had significantly reduced elbow pain with activity at 2 weeks, reduced epicondylar tenderness at 6 and 12 weeks, and an increase in wrist extensor mean peak force and total work at 24 weeks. At 6 months, 81% of treated patients were asymptomatic during activities of daily living, compared with 60% of patients who had tendon rehabilitation alone.
Conclusions: Application of topical nitric oxide improved early pain with activity, late functional measures, and outcomes of patients with extensor tendinosis.

Paoloni JA, Appleyard RC, Nelson J, Murrell GA. Topical nitric oxide application in the treatment of chronic extensor tendinosis at the elbow: a randomized, double-blinded, placebo-controlled clinical trial. Am J Sports Med. 2003 Nov-Dec;31(6):915-20. doi: 10.1177/03635465030310062901. PMID: 14623657.

Lateral Epicondylitis- Treatment

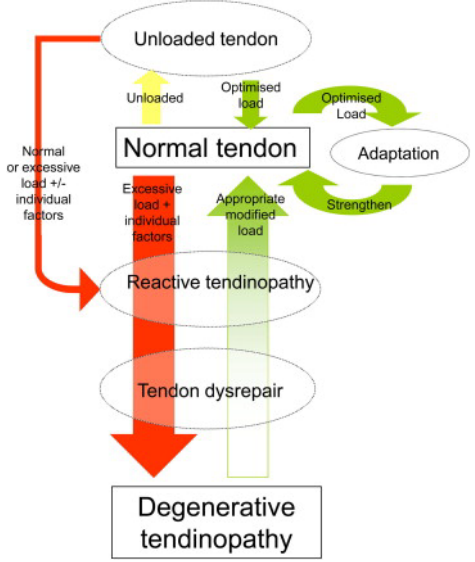
Mishra A and Pavelko T. AJSM. 2006:

- Cohort Study [Level II]: 20 pts failed PT, non-operative care (~ 15 m)
- PRP or bupivicaine → VAS, Mayo score
- 4 wks: 46% improvement (vs. 17%)
- 8 wks: PRP 60% improved VAS (vs. 16%)
- 6 months: 81% improvement in VAS
- ~ 25 m: 93% reduction in pain compared to pre-injection

Peerbooms J. AJSM. 2010

- Double Blind Randomized Control Trial: 51 pts PRP vs 49 steroid ➔ VAS, DASH
- 49% Steroid group vs 73% of PRP successful at one year follow up
- Steroid group initially did better but declined over the year

Lateral Epicondylitis- Treatment



- Optimum rehabilitation goals are to restore:
  - the load function of the tendon
  - adequate tendon stiffness
  - adequate stretch-shortening behavior
  - load dissipation
  - an effective kinetic chain
  - a pain-free state.
- Loading programs:
- Load Capacity (Jill Cook, Sean Docking)
  - Think about the load capacity of local tissues but also consider the capacity of the entire kinetic chain
    - Local tissue at site of injury
    - Kinetic chain (specific to sport and daily life
  - Concentric – some evidence that this may be effective
  - Eccentric – best treatment available
  - Isometrics – give some short-term pain relief and cortical inhibition, and may be good for reactive/compressive tendinopathy
  - Heavy slow resistance – seems to be effective in patellar tendinopathy, now also evidence in Achilles tendinopathy.
    - Concentric/Contraction for 3 seconds followed by eccentric phase 3 seconds
    - Associated with greater collagen turnover
    - Higher patient compliance and better patient satisfaction

https://www.physio-pedia.com/Tendon_Pathophysiology

Lateral Epicondylitis- Treatment

- Factors favoring surgical treatment
  - Severe pain or marked dysfunction for a minimum of six months
  - Failure of conservative management, including properly performed physical therapy over twelve months
  - Patient uninterested in pursuing nonoperative treatment options
- Patients with residual tendinopathic tissue have worse outcomes

Post-learning quiz

- True or False
  - Most meniscal tears in patients <30 years of age are due to degenerative arthritis

Post-learning quiz

- The talar tilt test, tests the stability of which ankle ligament
  - Deltoid ligament
  - CFL
  - Tib-Talar ligament
  - Maisonneuve ligament

Post-learning quiz

- True or False
  - Approximately 45% of patients have recovered from concussion by 4 weeks post-injury

Post-learning quiz

- Approximately what percentage of partial thickness rotator cuff tears progress to full thickness tears within 3 years?
  - 100%
  - 40%
  - 75%
  - 10%

Post-learning quiz

- Which of the following conditions can sometimes mimic the initial symptoms of lateral epicondylitis
  - Radial tunnel syndrome
  - Cubital tunnel syndrome
  - Carpal tunnel syndrome
  - C2 Cervical radiculopathy
  - Golfer’s elbow

Thank you!

Questions?

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