Current Clinical Practice Guidelines for Achilles Tendinopathy
An Evidence Based Approach to the Evaluation and Treatment of Achilles Tendon Disorders

Jaime L. Caillet, PT, DPT, OCS, Cert. DN

- Relevant Anatomy
- Tendon Science Review
- Achilles Tendon Disorders: Epidemiology and Etiology
- Evidence Based Diagnosis and Treatment:
  - Noninsertional Achilles Tendinopathy
  - Insertional Achilles Tendinopathy
  - Achilles Tendon Rupture

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Achilles tendinopathy: Epidemiology/Etiology

- Achilles tendon disorders one of most frequent overuse disorders in the literature
- Recreational or competitive athletes but also can occur in more sedentary population
  - Annual incidence in runners: 7-9%
  - Common age 30-50 yrs
  - Males>Females

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Epidemiology/Etiology

- Largest and strongest tendon in body not encased in a true synovial sheath but a paratenon, which is single cellular layer of fatty tissue
- Bloody supply evident at 3 locations: muscle-tendon junction, along course of tendon, and tendon-bone insertion with vascular density being least in mid portion of tendon

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Epidemiology/Etiology

- Intrinsic Risk factors: abnormal DF ROM, abnormal subtalar ROM, decr PF strength, incr pronation, comorbidities like obesity, HTN, incr cholesterol and DM
- Extrinsic risk factors: trng errors, environmental factors, faulty equipment

Epidemiology/Etiology

- Etiology remains unclear but histological evidence continues to show absence of prostaglandin-mediated inflammation
- Treatment strategies have been geared away from anti-inflammatory strategies

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Tendon
Wang et al

• Tendons are live, mechano-responsive tissue
  – Can adapt to loading condition, i.e. appropriate, excessive, disuse/immobilization

• Composition/Structure:
  – Type I collagen (70-80% dry weight)
  – Proteoglycans: aggrecan, decorin
  – Glycoproteins: tenasin-C, fibronectin, elastin
  – Tenocytes
  – Tendon stem cells (TSCs)

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Stress-Strain Curve

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Physiological Mechano-response of Tendon

- Loading enhances mechanical properties, may possibly delay aging response
- Loads induce biochemical changes
  - myofibroblasts present indicate active repair/remodeling in micro-injured tendon due to demanding mechanical loads
- Acutely injured tendon may benefit from mechanical loading via early mobilization
  - Incr tensile strength, reduced adhesions

Pathological Mechano-responses

- Excess mechanical loads (overloading/overuse): incr cellularity, cause abnormal collagen fiber organization
  - Reduced mechanical properties: elastic modulus and max stress at failure with tendon overuse
- Incr production of PGE$_2$ (inflammatory mediator):
  - Cause TSCs to differentiate into non-tenocytes
  - Incr Leukotrienes which induces neutrophil infiltration and tissue edema

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Pathological Mechano-responses

• Disuse +/- immobilization causes:
  – Changes in tendon cell shape, cell #, collagen fiber alignment and eventually causes tendon degeneration
  – Tendons may atrophy, have reduction in total weight, stiffness and tensile strength

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Pathological Mechano-responses

• Repetitive cyclic loading/stretching found to have anti-inflammatory effects at small magnitudes and pro-inflammatory effects at large magnitudes on tenocytes
  – Experiments have found: incr proliferation of tenocytes, incr type I collagen, incr COX-2 and MMP-1 gene expression

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**Tendon Stem Cells (TSCs)**

- Characteristics of adult stem cells: self-renewal, clonogenicity, multipotency
- In-vivo can generate tendon-like tissues; by default differentiate into tenocytes
- Excessive mechanical loads have found TSCs undergo aberrant, non-tenocyte differentiation
  - Adipocytes, osteocytes
  - Consistent with findings of tendinopathy

**Examining and Evaluating the Foot and Ankle: Achilles Tendon Disorders**

- Subjective
- Location and nature of pain
- Mechanism of injury
  - Can aid in special test selection
- Symptom Behavior
  - Morning pain, pain during training, night pain
- Activity limitations
Objective Exam

- Visual inspection
- Palpation
- Gait Assessment
- ROM
- Strength
- Special Tests
- Functional Testing

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Single Heel Rise
Jan et al

- Subjects age 21-80 without lower limb injuries
- Non exercising individuals/sedentary
- Terminated test for <50% max angle

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<td>61-80</td>
<td>4.1 ± 1.9</td>
<td>61-80 = 2.7 ± 1.5</td>
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Noninsertional Achilles tendinopathy:
Diagnosis

• Intermittent pain related to ex or activity
• Stiffness upon WB after prolonged immobility
• Stiffness or pain at start of activity that eases but as condition progresses can be throughout activity session eventually leading to stoppage

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Diagnosis

• Positive achilles tendon palpation test:
  – Local tenderness 2-6cm prox to insertion
• Decr PF strength, endurance
• Arc sign: area of swelling moves with PF/DF (Sn 0.52, Sp 0.83)²

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Diagnosis

• (+) Royal London Hospital test
  – Tenderness 3 cm prox to calcaneus with ankle in slight PF that decr as ankle is DF (Sn 0.54, Sp 0.91)

• Examination should also include functional assessment: walk ability, descend stairs, perform unilateral HR, single limb hop²

Treatment

• Alfredson **eccentric training** protocol has good results with athletic individuals with mid portion achilles tendinopathy
  – B HR with unilateral lowering off step 3 x15, bent and straight knee, 2x per day
  – Slow, controlled without disabling pain
  – Progress with external resistance via backpack
  – Success rate 89% in active individuals, 56% in sedentary individuals⁸
Treatment

• Stevens et al looked at 2 groups:
  1. Alfredson protocol of 180 reps/day
     – Mean 166/day
  2. “Do as tolerated” per day
     – Mean 112/day

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Stevens et al

• Both groups had within group changes on VISA-A and VAS similar to other research on Alfredson Protocol at wk 6
• No statistically significant diff. in change scores at 6 wks on VISA-A score, VAS pain score btw groups

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Stevens et al

- Results were comparable to other studies using Alfredson protocol
- Patient tol may be higher using this protocol and greater self efficacy because taking active role in rehab
- Optimal dosing for ECC ex remains unclear

Stevens et al: Limits

- No confirmation by diagnostic imaging, MRI, ultrasound for dx
- Performance related outcome measures not included as in previous studies like: countermovemet jump, concentric toe raise and standing toe raise test
- Inter- and Intra- reliability not determined for this study which had numerous data collectors (8)

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Treatment: Silbernagel et al

- Prospective RCT (N=38) evaluating Achilles tendon-loading strengthening program and effect of cont. running/jumping during treatment of non-insertional Achilles tendinopathy
  - **Exercise trng group**: Used pain-monitoring model, pain not >5 on VAS and could cont. Achilles loading activities during first 6 wks
  - **Active rest group**: Could not perform physical activity that caused the sx or any other Achilles loading activities that involved running or jumping during first 6 weeks

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Treatment Protocol: Phase 1: Weeks 1-2

- **Patient status**: pain and difficulty with all activities, difficulty performing 10, 1 legged toe raises
- **Goal**: start to ex, education about injury, pain monitoring model
- **Treatment**: 1x per day
  - Circulation exercise (PF/DF)
  - 2 legged toe raises on floor (3x 10-15 reps)
  - 1 legged toe raise on floor (3x10)
  - Sitting toe raises (3x10)
  - Eccentric toe raise on floor (3x10)  \(^{10}\)

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Phase 2: Weeks 2-5

- **Patient status**: pain with exercise, morning stiffness, pain with toe raises
- **Goal**: start strengthening
- **Treatment**: Daily exercise
  - 2 legged toe raise standing on edge of stair (3x15)
  - One legged toe raise standing on edge of stair (3x15)
  - Sitting toe raise (3x15)
  - Eccentric toe raises on standing on edge of stair (3x15)
  - Quick rebounding toe raises (3x20)

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Phase 3: Weeks 3-12 (longer if needed)

- **Patient status**: handled phase 2 program, no pain distally in tendon insertion, possibly decr or incr a.m. stiffness
- **Goal**: heavier strength training, start or increase running and/or jumping activity
- **Treatment**: perform daily and with heavier load 2-3x/wk
  - 1 legged toe raise on edge of stair with added weight (3x15)
  - Sitting toe raise (3x15)
  - Eccentric toe raise standing on edge of stair with added weight (3x15)
  - Quick rebounding toe raises (3x20)
  - Plyometric training

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Phase 4: weeks 12-6 months (longer if needed)

• **Patient status**: minimal sx, morning stiffness not everyday, can participate in sports without difficulty

• **Goal**: Maintenance ex, no symptoms

• **Treatment**: Perform exercise 2-3x/week
  – 1 legged toe raises standing on edge of stair with added weight (3x15)
  – Eccentric toe raises on edge of stair with added weight (3x15)
  – Quick rebounding toe raises (3x20)

Results
Silbernagel et al

• **Exercise trng group**
  – VISA-A-S mean (SD)
    • 57 (15.8) at baseline
    • 85 (12.7) at 12 month follow up, (P <.01)

• **Active rest group**
  – VISA-A-S mean (SD)
    • 57 (15.7) at baseline,
    • 91 (8.2) at 12 month follow up, (P<.01)
Results
Silbernagel, et al

• No significant difference in change of scores for hopping in both groups or difference in rate of improvement
• No negative effects of allowing pts. to cont. tendon loading activity
• Study results consistent with earlier results for current ex protocol
  – decr symptoms and incr muscle-tendon function

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Limits:
Silbernagel et al

• Type II error because power calculation run for primary outcomes not secondary
• Gender ratio may be confounding factor
• Results difficult to compare due to variations in outcome measures used
  – Recommend VISA-A-S for future studies to allow comparisons

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Treatment:
Clinical Practice Guideline Recommendations

• **Iontophoresis**
  – Sx < 3 months in duration treated 4 treatments over 2 wks with 3 ml 10% Dexamethasone f/b 10 wks of rehab
  – Less pain during walking, post activity found vs control at 6 and 12 months\(^9\)
• **Moderate Evidence** for use with Achilles Tendinopathy\(^2\)

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Treatment:
CPG Recommendations

• **Orthotics** have biomechanical basis due to association between excessive pronation and incr stress at AT but evidence **Weak** by recent Clinical Practice Guideline
• **Weak** Evidence for **Stretching**\(^2\)

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Treatment: CPG Recommendations

- **Taping** has limited research on the effectiveness but anecdotally has been shown to help with short term pain relief
  - Rocktape, Kinesiotape, pronation control taping
- Expert opinion graded F

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Taping Techniques
Treatment: CPG Recommendations

- Extracorporeal Shockwave Therapy (ESWT)
  - Strong evidence to support but may not be cost effective
  - Found to have improved outcomes when added to ECC protocol at 4 mos with lower pain but at 1 yr scores were not significantly different\(^9\)

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Treatment

- IASTM
  - Case report combining Alfredson protocol with IASTM for 53 y/o female with mid portion achilles tendonitis
  - 2x per wk x 10 visits with pain free report at 10\(^{th}\) visit
  - Quicker than usually reported times for ecc trng alone (12 wk program)

- Other techniques: heel lifts, night splints, low level laser therapy with ltd evidence\(^8\)

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Insertional Achilles Tendinopathy: Diagnosis

• Tenderness along distal 2cm of Achilles insertion
• AM Pain and stiffness reported
• Swelling may be visible and incr with activity

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Diagnosis

• Can also exhibit combined pathology like superficial or retrocalcaneal bursitis
• Approximately 80% have Haglund’s deformity
• Approximately 70% have calcifications within the tendon$^5$

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Diagnosis

- Retrocalcaneal bursitis: inflammation of bursa with pain ant. to achilles tendon
- Dx with 2 finger squeeze test: pain with pressure applied med/lat to tendon

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Jonsson et al

• Theorized that Achilles tendon was subject to compressive forces in DF due to impingement between tendon, bursa and bone
• 3x15, twice per day for 12 wks
• 67% satisfied pts. With pain reduction on VAS from 69.9 to 21.0 (p<0.001)
Treatment: Jonsson et al

- Eccentric program less successful for IAT at 32% success rate
- Modified the eccentric program to not involve going into DF ROM (exercise on floor only)

Jonsson et al: Limits

- Small sample size
- No control group
- Short duration follow-up
Achilles Tendon Rupture: Epidemiology/Etiology

• Most frequently ruptured tendon
• Can be acute traumatic, chronic, or chronic attritional ruptures, or combination of age related factors and acute trauma

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Epidemiology/Etiology

• Occurs during running and jumping without any warning signs in a typically highly active patient group
• Often pt. middle aged male involved in recreational sports
• Recommend return to running and jumping typically 16-24 wks

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Diagnosis

AAOS recommends with good quality evidence:
• Detailed Hx/PE. PE with 2 or more of following tests to establish dx of acute tendon rupture:
  – Clinical Thompson test (Simmonds squeeze test).
  – Decr ankle PF strength.
  – Presence of palpable gap (defect, loss of contour).
  – Incr passive ankle df with gentle manipulation.
• C/o burning sensation or sharp stabbing pain in region of achilles

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Treatment: Willits et al

• No universally agreed upon treatment when considering surgical vs. non surgical
• Willits et al (N=144) in a RCT compared an accelerated protocol for acute achilles tendon rupture (<14 days) using op and non op treatment

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Willits et al

• All received removable below knee orthosis with 2 cm heel lift, ~20° PF, protected WB x2 wks, WBAT at 4 wks, functional boot x 8wks

• Rerupture rate= 2 for operative group at 1 and 3 mos. after surgery and 3 for nonop at 1,2,and 3 mos. after injury

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Asterisk denotes significant difference ($p \leq 0.05$) between op and non-op group

**Willits et al: Limits**

- Underpowered due to small sample size to decide definitive conclusions regarding rerupture rate
- Estimated to need 1275 per group to prove that reduction in rerupture is real
  - Appears that addition of early WB and mobilization reduced rupture when compared to other conservative studies
Treatment

• Barford et al: non op management after acute rupture with an immediate WB vs. control and NWB (x 6 wks)
  – Orthosis with wedge progression to neu;
  – Supervised PT from 9-16 weeks
  – 3 reruptures in WB, 2 in NWB
  – Return to sport: WB: 143d, NWB: 181d
  – HR test did not differ between groups

Evidence Based CPG on Diagnosis and Treatment of Acute Achilles Tendon Rupture

AAOS finds moderate evidence:
• Early postoperative WB (< 2 weeks)
• Use of protective device that allows mobilization by 2-4 wks postop suggested
• No consensus on type of device and degree of PF
• AAOS finds **weak evidence**:
  – Nonoperative treatment is an option for all patients with acute Achilles tendon rupture.
  – Operative treatment is an option in patients with acute Achilles tendon rupture

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What treatment is superior: Op vs Non op?  
**Systematic Review of Meta-Analyses**  

• Recent decline in Achilles tendon (AT) ruptures treated operatively but evidence varies widely
• Hypothesis: Op treatment of AT rupture would offer lower rate of rerupture but higher complication rate than non op treatment
• 9 studies which performed a meta-analyses between 1997-2013 that met criteria and considered best available evidence for treatment recommendations
  • 2833 subjects in op group
  • 2355 subjects in non op group

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Erikson et al

- Hypothesis confirmed: 7/9 studies concluded that surgery decr rerupture rates compared with nonop treatment
- 8/9 studies found patients in surgery group had higher rate of complications
  - Infection (deep/superficial), adhesion formation, sural nerve injury
- Significant variability in functional outcome measures used in the meta-analyses

What do we know now?
Erickson et al

- AAOS guidelines recommend caution when pursuing op treatment
- Significant caution given to diabetics, smokers, pts with neuropathy and other poor wound healing potential due to complications and wound issues
- Functional rehab recently finds this may lead to lower rerupture rate and RTW
- Functional outcomes varied and reveal a significant gap in the literature
- Treatment should be individualized
Strengths/Limits: Erikson et al

- **Limits:**
  - Limits in the studies included in the meta-analyses carry over to this study
  - Potential heterogeneity and/or nonreporting of pts. Lost to follow-up
  - Time from injury to surgery was not recorded regularly
  - Variability in rehab protocols, surgical technique, preop data

- **Strengths:**
  - Use of multiple independent validated quality assessment tools
  - 3 authors applied methods and came to consensus agreement
  - Inclusion of highest quality studies surrounding subject of AT rupture
  - Most studies included were Level 1 evidence

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Post-Operative Rehab
Strom and Casillas

- **Period of immobilization in equinus position**
  - Least stress on wound and repair; perfusion least impeded in this position

- **Avoid detrimental effects of joint immobilization**
  - Joint stiffness, muscle atrophy, tendocutaneous adhesions, DVT, ulceration of joint cartilage

- **Traditionally 6-8 wks of immobilization but recent research suggesting**
  - early WB does not impair recovery, improves soft tissue healing, decr muscle atrophy, and improves orientation of new collagen fibers
  - Study comparison remains difficult due to rehab protocol differences

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Post Operative Considerations

• **Age**: consider cellular changes with incr age incr collage cross-linking; new structures typically stiffer and have an overall decr in elasticity
  • May need longer warm up/cool down

• **Smoking status**: effects healing process by impeding blood flow to the skin; cellularly can decr proliferation of RBCs, fibroblasts and macrophages→→→key to wound healing

• **Current medications** which affect tendon structure like corticosteroids, fluroquinolone antibiotics

• **Systemic diseases**: RA, SLE-may have weakened collagen and degraded joint surfaces may impede tendon healing

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Rehabilitation Goals

Strom and Casillas

• **Address post operative pain and swelling**
  • Massage, ice, graduated compression garment, estim

• **Recover motion with consideration of repair’s integrity**
  • DF recovered by warm up and stretching typically
  • Stiff joints don’t do well with forced ROM-compressive to the joints so joint distraction and translations may assist before ROM

• **Strengthen gastroc-soleus with graduated progression of resistance**
  • Tubing, closed-chain exercises (seated heel raise→B heel raise →single heel raise on floor → single heel raise off step → single heel raise on balance board/trampoline

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Rehabilitation Goals

• Restore strength and coordination of entire lower extremity
  • Swimming, underwater jogging, cycling

• Provide healthy return to sport, work
  • Avoidance of reinjury/rupture
  • Cross training, cycling, aquatic therapy promote aerobic recovery and coordination of LE

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Achilles Tendon Rehab Protocol

UW Health and Sports Rehab

• 0-2 weeks post surgery
  • Begin rehab at approximately 2 weeks
  • Protect repaired tendon and monitor wound healing
  • Bilat axillary crutches with NWB/TTWB in boot in 20-30° PF
  • Avoid dependent position to assist wound healing
  • CV ex: UBE

• 2-4 weeks post surgery
  • N gait with WBAT using boot/crutch, protect repair
  • Gradually decr PF to 0°
  • Active DF to neutral (bent knee)
  • Exercises: pain free active ankle AROM (ABCs, AP), isometrics of inv, ev, DF, sub-max PF, open chain hip and core strengthening

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Achilles Tendon Repair Rehab Protocol

• Progress to next phase if: wound healed/no complications, pain free active DF to neutral
• 4-8 weeks post surgery
  • Wean from boot and use 1-2 1/4” heel lift in tennis shoes and gradually remove heel lift from 5th-8th week
  • Avoid over stressing repair: large sagittal plane movements, forceful PF in DF position, aggressive PROM and high impact activities
  • Exercise: frontal and sagittal plane stepping drills, ankle AROM, gentle gastroc-soleus stretching (consider starting in bent knee position), static balance exercise with double to single limb progression, ankle tubing strengthening, functional squat, lunge, hip and core strengthening, pool if wound healed

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Achilles Tendon Repair Rehab Protocol

• Progression to next phase if: normal gait without boot, squat to 30° knee flexion with symmetrical WB, SLS x10 sec with good control, AROM 5° DF to 40 PF °
• 8 weeks post surgery: Nomralize gait on all surfaces without lift, AROM 15° DF to 50 PF °, good control and no pain with functional movements like step up/down, squat, lunges
• Exercises: frontal/transverse plane agility drills with progression from low to high velocity then to sagittal plane drills, Gastroc/soleus stretching, multi-plane proprioceptive SLS exercise, ankle strengthening both conc/ecc

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Achilles Tendon Repair Rehab Protocol

• Progression to next phase: normal gait on all surfaces, squat and lunges to 70° knee flexion symmetrically, SLS 10 seconds, AROM 15° DF to 50 PF°

• 4 months post surgery:
  • Monitor for post activity soreness which should resolve in 24 hours
  • Post activity swelling, running without any limp
  • Exercise: Impact exercises beginning with 2 and progressing to 1, multiplane exercises in single to multiplanes, sport/work specific drills

• Return to work/sport: good dynamic neuromuscular control without incr pain or swelling

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