Patellar Tendinopathy in Alpine Skiers - Current Diagnostic and Therapeutic Recommendations

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no collisions of interests





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Gina Stechert finished her sports career. The 27-year-old speed specialist was part of the German Ski Team (DSV) for ten years.

Persistent knee problems after a tear of the patellar tendon of her left knee forced her to end the career.

DEUTSCHER SKIVERBAND

Anna Fenninger

Oct. 21. 2015

Dx: Rupt. tend. pat. sin.
Rupt. lig. cruc. ant. sin.
Rupt. lig. coll. med. sin.
Leas. men. med. et lat. gen. sin.

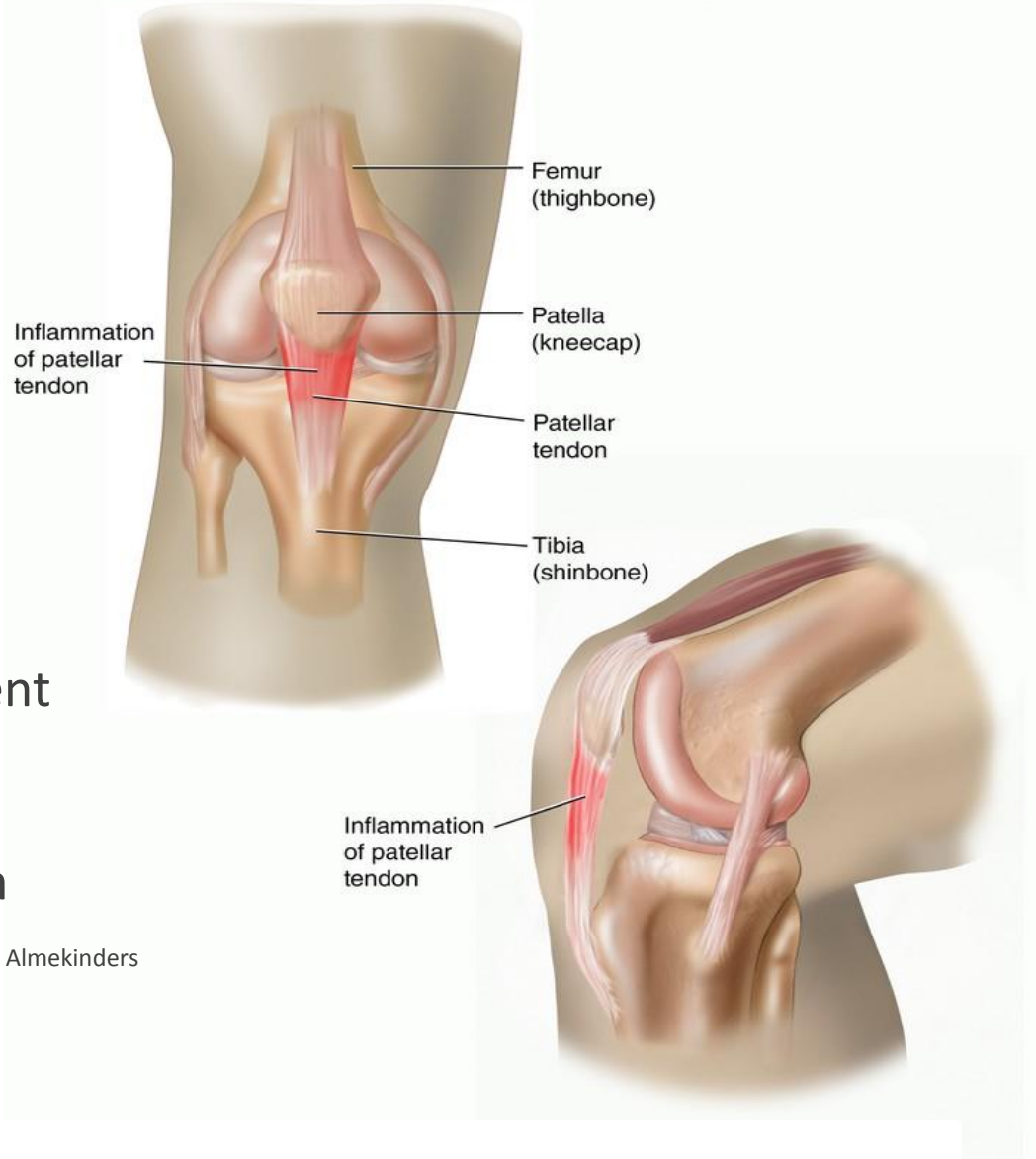
Introduction

Definition

Patellar tendinopathy

activity-related
gradually progressive
pain and dysfunction
at the proximal tendon attachment
Torstensen et al; 1994

overuse syndrome resulting from
high loads to the patella tendon, Almekinders et al, 1998; Khan K, Cook J; 2003;



Prevalence

highly affected by type of sport

Zwerver J, Bredeweg SW, van den Akker-Scheek I; 2011

- sports with high impact ballistic loading to knee extensors
  - rapid acceleration - deceleration, jumping - landing
  - micro tears due to overuse and extreme forces

  Torstensen Eric T, Bray Robert C, Wiley J; 1994

- substantially higher in elite athletes
  - recreational athletes: highest in basketball and volleyball (>14%), lowest in soccer players (<2.5%)
  - elite athletes: 44% in volley-ball, 32% basketball

  Zwerver J, Bredeweg SW, van den Akker-Scheek I; 2011; Cook JL, Khan KM, Kiss ZS, Griffiths L; 2000

in asymptomatic elite athletes 22% tendon pathology

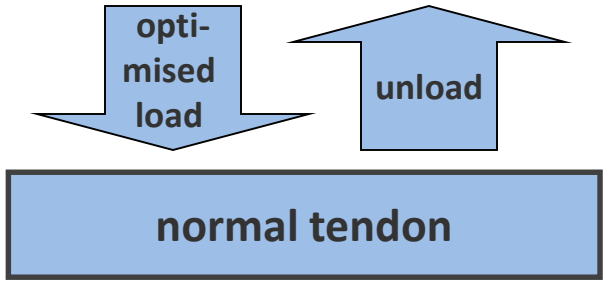
male : female athletes = 2 : 1

Cook JL, Khan KM, Kiss ZS, Griffiths L; 2000

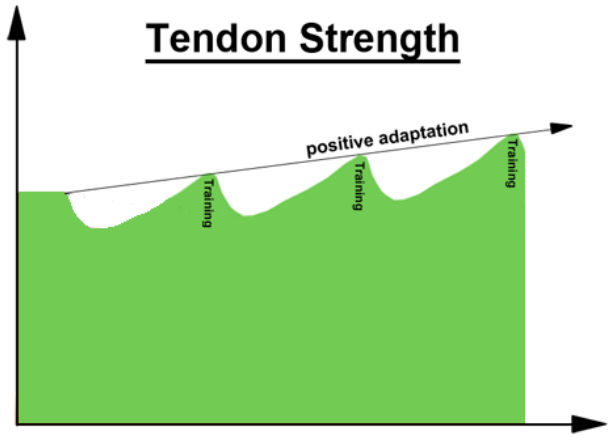
Etiology

continuum model

Cook JL, Purdam CR; 2009; Peers KH, Lysens RJ; 2005;



adaptation and strengthening



adapted from: Rudavsky, Cook, 2014; Finley and Rodgers, 2004; Forde et al., 2005

Etiology

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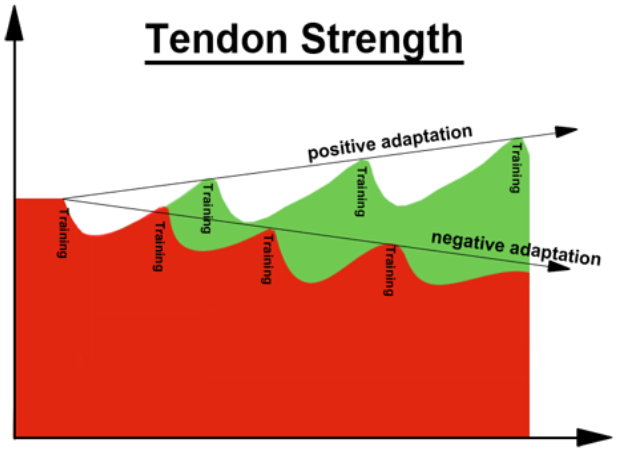

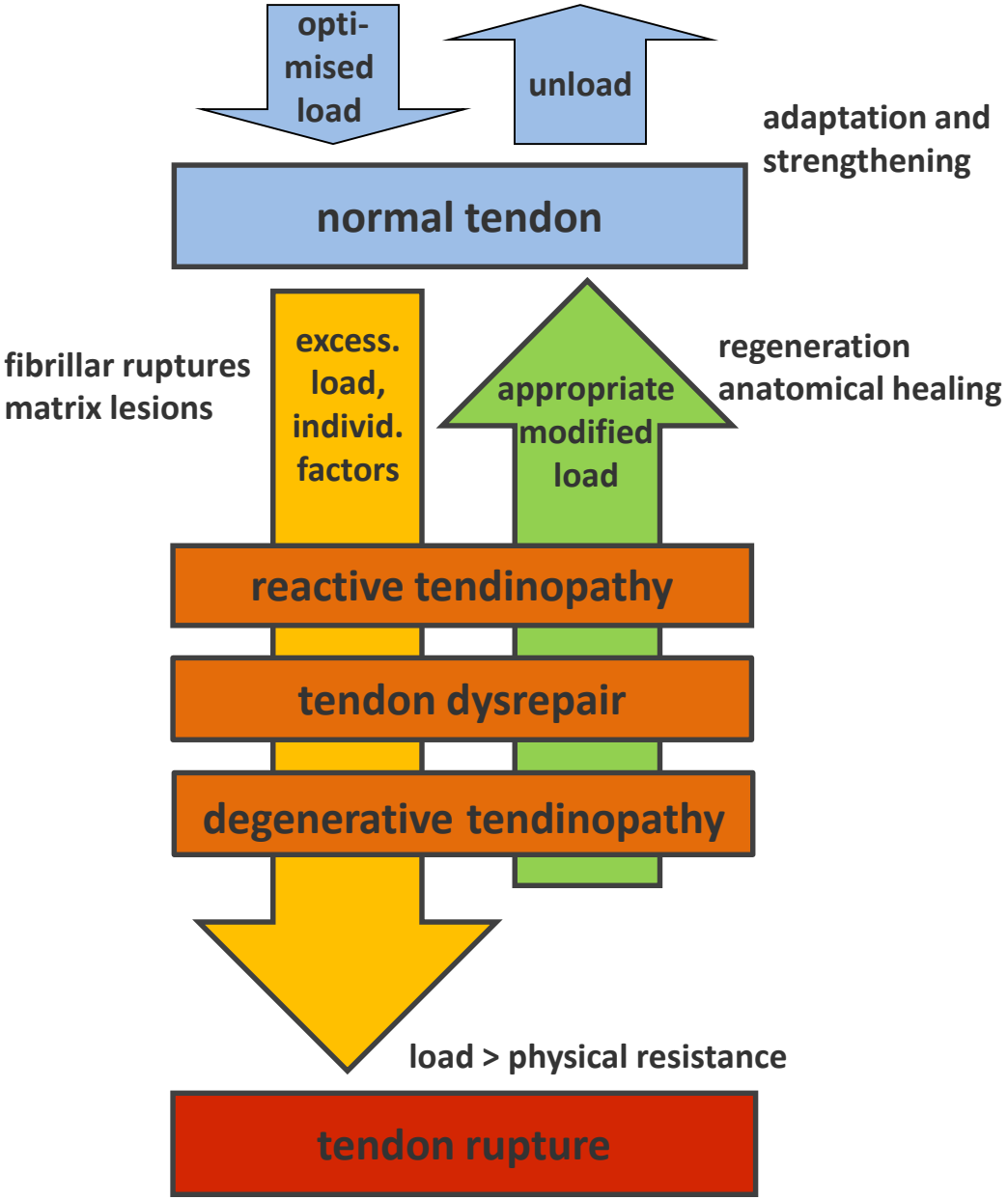

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Etiology

continuum model

Cook JL, Purdam CR; 2009; Peers KH, Lysens RJ; 2005;

reactive tendinopathy

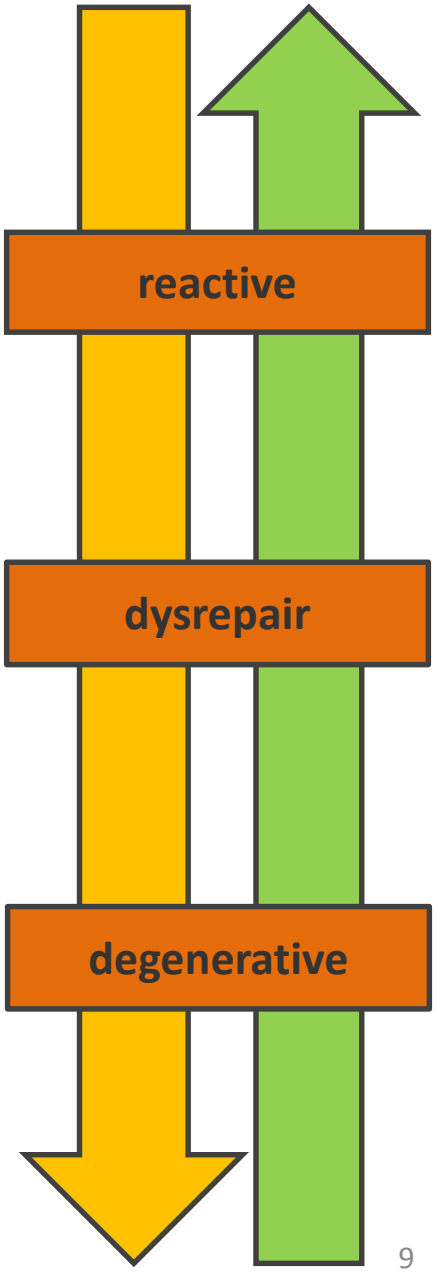
- response to a rapid increase in loading
- tendon remains structurally intact
- minimal change in collagen integrity
- reversible process

tendon dysrepair

- continued excessive load
- change in tendon structure,
- fibrillar ruptures and matrix breakdown
- increase in vascularity and neuronal ingrowth

degenerative tendinopathy

- chronic overloading
- multiple tendon structure changes
- disorganised collagen, advanced matrix breakdown
- increased vascularity and neuronal ingrowth
- risk of tendon rupture



Etiology
Pain

etiology of pain is independent of tendon pathology

associated with pathological tendons,
but also in normal tendons
Malliaras P, Cook J; 2006

degenerativ tendons can be pain free
Kannus, Jozsa, 1991

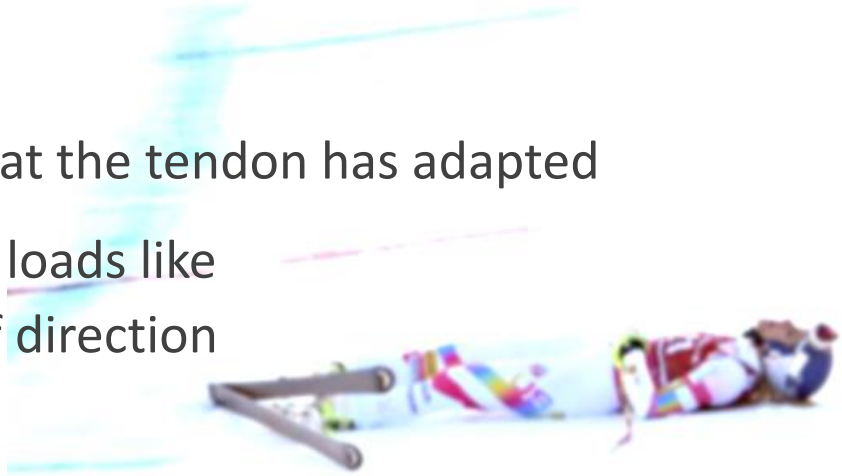
tissue damage occurs before pain is felt
Huisman et al, 2013; Khan et al, 1998

key factor of pain onset

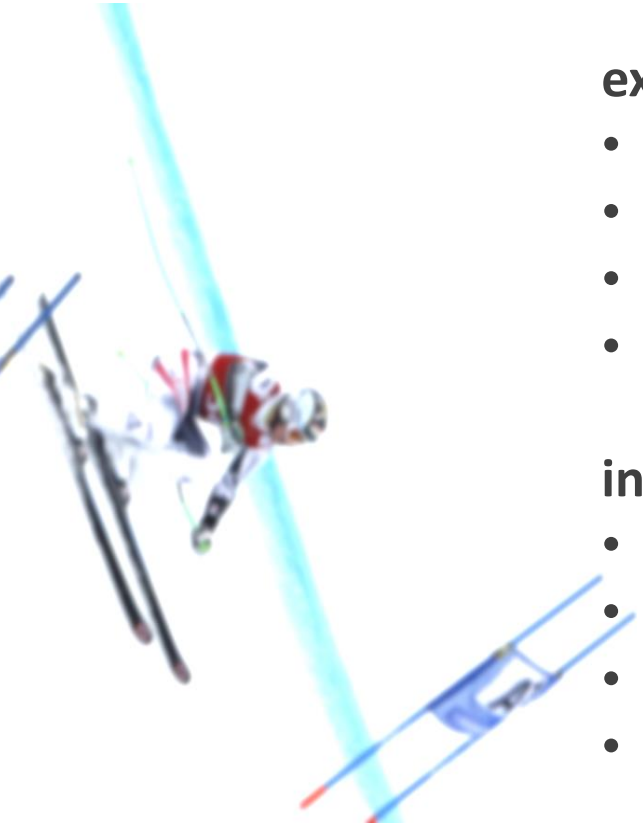
overload: activity above what the tendon has adapted

typically energy storage and release loads like

jumping, landing, change of direction
Gaida JE, Cook JL, Bass SL, Austen S, Kiss ZS; 2004



Etiology
Risk and associated factors



extrinsic factors

- rapid increase of frequency or intensity of training
- transition from one training method to another
- improper rigid training surfaces
- insufficient foot-wear/ inappropriate equipment

intrinsic factors

- anthropometric characteristics
- improper body- and movement mechanics
- abnormalities of the knee joint, and/or
- poor base strength of the quadriceps muscles

Johannes Zwerver, Evert Verhagen, Fred Hartgens, Inge van den Akker-Scheek and Ron Diercks ; 2010

Assessment
Examination

Inspection

atrophy of the quadriceps and calf muscles

Palpation

tenderness to palpation, thickening and pain
over the inferior pole of the patella

Functional tests

single-leg decline squat on a 25 deg decline board
increases the moment arm of the knee,
angles above 15 deg are equivocal

Purdam CR, Jonsson P, Alfredson H, Lorentzon R, Cook JL, Khan KM; 2004;

various single-leg hop tests

muscle strength, joint ROM

Treatment

Surgery

surgical treatment is a common procedure with little evidence
no advantage compared to other forms of nonoperative treatment
Bahr R, Fossan B, Loken S, Engebretsen L; 2006;

only as a part of a well designed rehabilitation program Cook JL, Purdam CR; 2014;

Education

regular pain and symptoms
monitoring on a daily basis

modifying of loading/
intrinsic and extrinsic factors
to actual symptoms

management of symptoms
throughout whole sporting career

Treatment

Controlled rest

no complete cessation of tendon loading activities

Kountouris A, Cook J; 2007;

complete unloading a tendon weakens it over time

Yamamoto et al 1999; Cook, Purdam 2009

Load management

athletes should be removed from sports during rehab

Visnes, Bahr, 2007

continuing regular training stops tendon healing

Visnes et al 2005

no overuse abuse, no jumping or deep squatting

pain free exercises without load, stationary cycling, aquatic exercises

Cook JL, Khan KM, Mafulli N; 2000;

Treatment
Physiotherapy management

Pain reduction

mechanism of pain poorly understood

central sensitisation or pathophysiological up- regulation of the central nervous system
Webborn AD; 2008; Rio E, Moseley L, Purdam C, Samiric T, Kidgell D, Pearce AJ, et al; 2014;

no evidence for neovascularisation as a primary pain driver Rees JD, Maffulli N, Cook J; 2009;

Treatment
Physiotherapy management

Pain reduction

sustained isometric contractions

4x 70% MVC, 45-60sec Naugle KM, Fillingim RB; 2012

in highly irritated tendons: bilateral exercises,
shorter holding time and fewer repetitions Cook JL, Purdam CR; 2014

weak evidence for modalities

cryotherapy, electrotherapy, pulsed ultrasound,
transverse friction massages

positive effect on pain reduction in short- and long-term follow-ups

useful in augmenting the exercise program and reducing pain
and symptoms in the sport-season

no benefit of extracorporeal shockwave therapy Zwerver J, Hartgens F, Verhagen E et al; 2011

no evidence for braces and taping techniques Stasinopoulos D et al; 2004; Pedrelli A et al; 2009

Treatment
Physiotherapy management

Strengthening exercises

eccentric exercises: good short-term and long-term effects

Frohm A, Saartok T, Halvorsen K, Renstrom P; 2007;

25 deg single-leg decline squats better than a single-leg flat squats

Purdam CR, Jonsson P, Alfredson H, Lorentzon R, Cook JL, Khan KM; 2004;

heavy slow resistance exercises and decline squat eccentric exercise show improvements at 6 months compared to corticosteroid inj.

heavy slow resistance group showed improved tissue normalisation of collagen and better clinical presentations

Kongsgaard M, Kovanen V, Aagaard P, Doessing S, Hansen P, Laursen AH, et al; 2009;

Treatment

Medical management

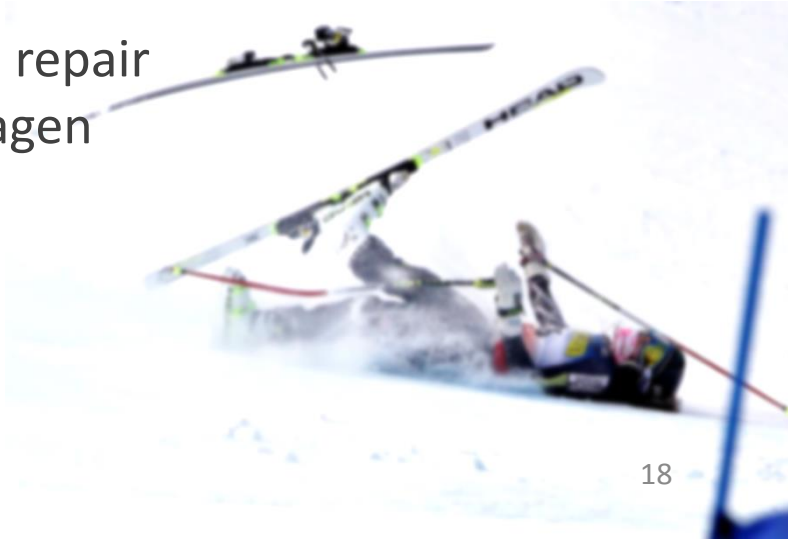
limited evidence for corticosteroid and other substance injections
in acute and chronic stage

peritendinous corticosteroid injection, oral steroidal medication or
iontophoresis may be useful for quick pain reduction in reactive tendon
Fallon K, Purdam C, Cook J, Lovell G. A; 2008

no corticosteroid injections in degenerative tendinopathy
long-term outcomes are worse than those obtained with exercise
Kongsgaard M, Kovanen V, Aagaard P, Doessing S, Hansen P, Laursen AH, et al; 2009;

NSAD´s and corticosteroids slow down tendon repair
negative effect on mechanical integrity of collagen
Cook, Purdam, 2009; Cook JL, Purdam CR; 2014;

platelet-rich plasma injections
positive outcomes in small sample sizes
van Ark M, Zwerver J, van den Akker-Scheek I; 2011;




Elisabeth Hospital
Dept. PM&R
Linz, Austria


2015
20th anniversary
PM&R

Example for a controlled tendon loading and muscle strengthening protocol

partial weight bearing eccentric squats

starting in pain free ROM
progression, when completed 3 sets/15 reps pain-free
increase of difficulty
- higher ROM, max 70 deg knee flex
- and/ or higher load, partial/ full weight bearing
  bilateral/ unilateral/ weighted squats
- execution of exercise
  eccentric/ concentric-eccentric,
  slow/ fast speed/ plyometric

hip and thigh strengthening

leg raises, sidelying hip abduction/ adduction,
prone hip extension

stretching exercises calf, hamstrings and quadriceps

Prognosis

return to sport dependent on severity of pain and dysfunction

mild tendon pathology associated with 20 days
more severe pathology approximately 90 days

Gemignani M, Busoni F, Tonerini M, Scaglione M; 2008;

reduction in pain 3-4 weeks

Rutland et al; 2010

complete tendon repair at least 3 month

Khan et al, 1998; Wilson, Best, 2005

high kinetic chain dysfunction 6 to 12 months

Lian OB, Engebretsen L, Bahr R; 2005;

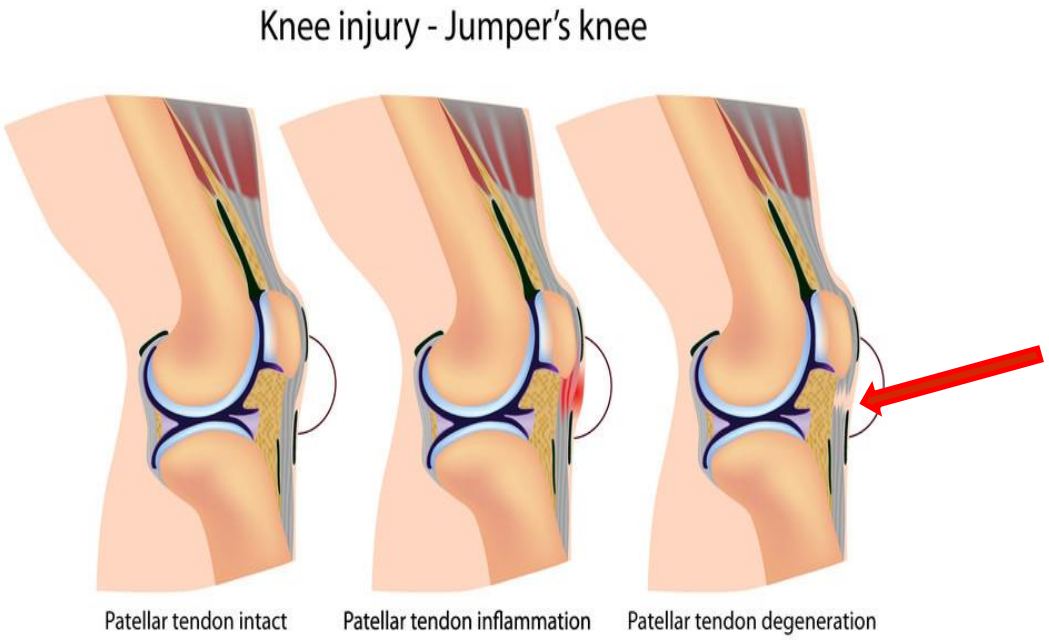
Differential Diagnosis

anterior knee pain

patellofemoral pain syndrome
Pathology of the plica or fat pad
patellar subluxation or dislocation
Osgood Schlatter disease

Calmbach WL, Hutchens M; 2003

Prevalence
Patellar tendon rupture



rare complication:
only 6% of all tendon ruptures of the body
majority occur in older population (mean age 65y)

Kannus P, Natri A; 1997

but: all patellar tendon ruptures had pathology in the tendon

Kannus P, Jozsa L; 1991

Treatment
Physiotherapy management

Functional strengthening and return to sports

addresses high-load tendon capacity
kinetic chain deficits and movement patterns

when they have improved, beginning of sports-specific training
faster contractions
progressive loads towards skipping, jumping and hopping and agility tasks like direction changes and sprinting

important to quantify these high-load activities

Diagnostic Procedures

signs and symptoms are easy to detect

- pain in the area of the tendon
  (origin of tendon inferior patella pole or main body of tendon)
- the knee feels "tight"
- pain experienced early in the workout and after the workout
- subtle swelling of the tendon
- tendon "squeaking" Khan K M, 1998

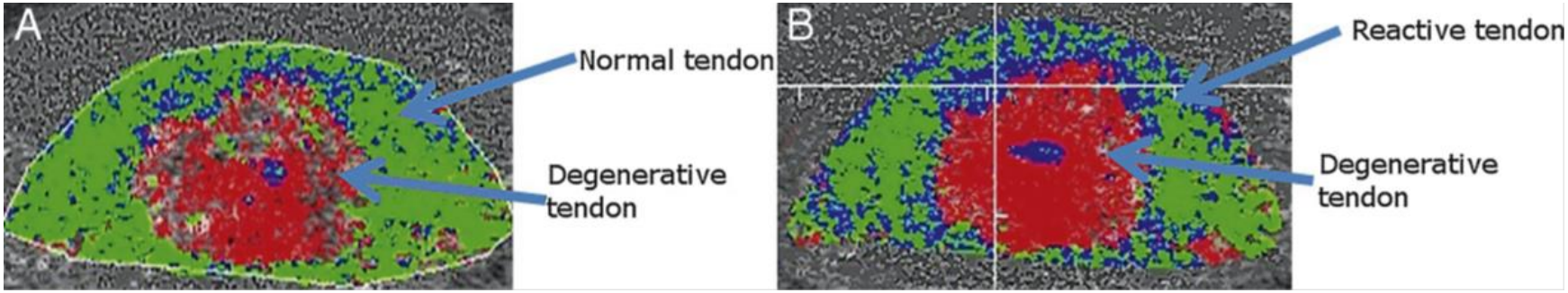
Activities that worsen Symptoms

- ADL´s: stair climbing, squatting, downhill walking
- Sport: jumping, weight lifting, jogging/ sprinting

Assessment

Imaging

ultrasound tissue characterisation



degenerative patellar tendon structure (A)

progressing to a reactive on degenerative patellar tendon structure (B)

Classification system of tendinopathies

Nirschl et al; 2003

Pathologic stages

Stage I	temporary irritation
Stage II	permanent tendinosis – < than 50% tendon cross-section
Stage III	permanent tendinosis – > 50% tendon cross-section
Stage IV	partial or total rupture of tendon

Classification system of tendinopathies

Nirschl et al; 2003

Phases of pain

Phase I	mild pain after exercise activity, < 24 hours
Phase II	pain after exercise activity, > 48 hours, resolves with warm-up
Phase III	pain with exercise activity, does not alter activity
Phase IV	pain with exercise activity that alters activity
Phase V	pain caused by heavy activities of daily living
Phase VI	intermittent pain at rest that does not disturb sleep; pain caused by light activities of daily living
Phase VII	constant rest pain and pain that disturb sleep

Pathologic stages do not corresponde with Phases of pain

NO PAIN ≠ NORMAL TENDON

tissue damage occurs before pain is felt Huisman et al, 2013; Khan et al, 1998

even severely degenerated tendons can be painfree Kannus, Juzsa, 1991

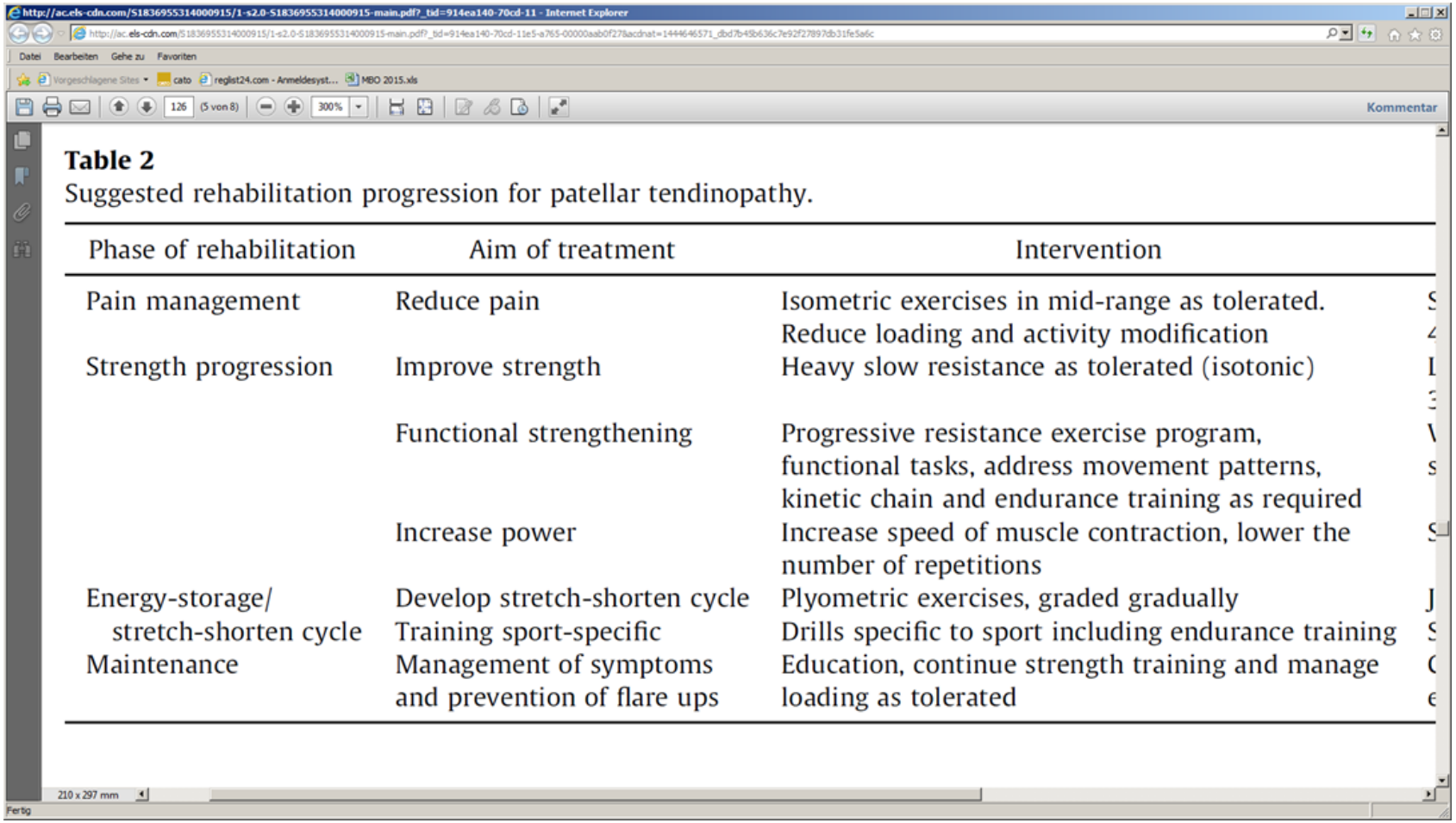
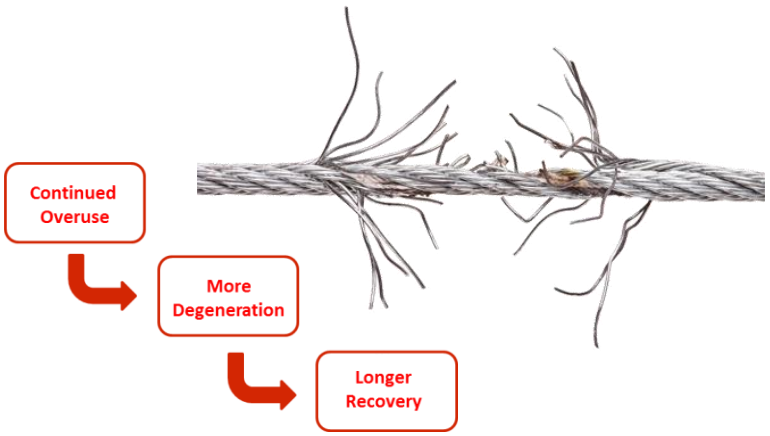


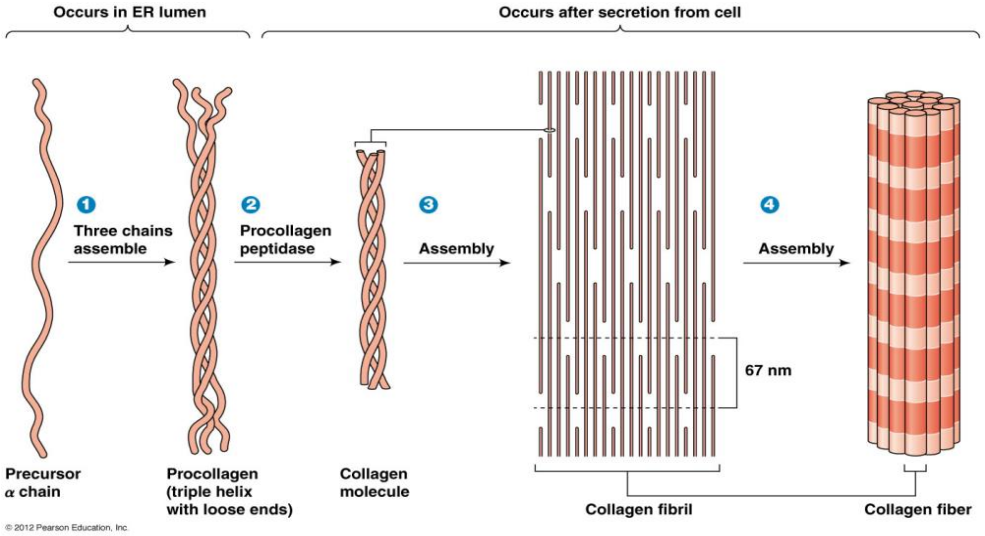
Table 2
Suggested rehabilitation progression for patellar tendinopathy.

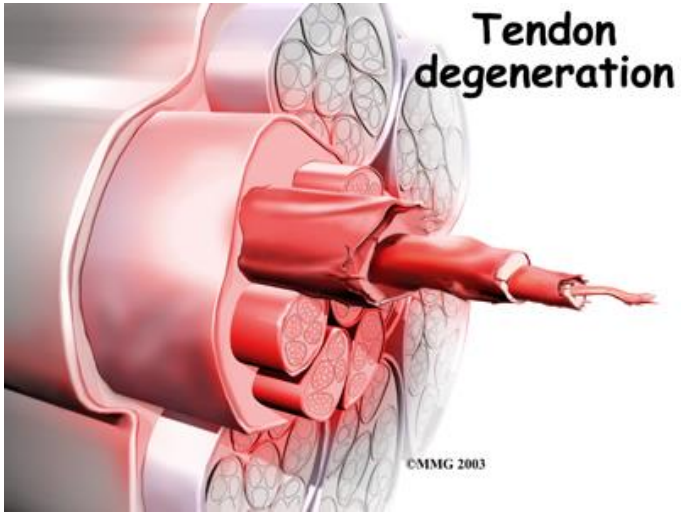
Phase of rehabilitation	Aim of treatment	Intervention
Pain management	Reduce pain	Isometric exercises in mid-range as tolerated. Reduce loading and activity modification
Strength progression	Improve strength	Heavy slow resistance as tolerated (isotonic)
	Functional strengthening	Progressive resistance exercise program, functional tasks, address movement patterns, kinetic chain and endurance training as required
	Increase power	Increase speed of muscle contraction, lower the number of repetitions
Energy-storage/ stretch-shorten cycle	Develop stretch-shorten cycle	Plyometric exercises, graded gradually
	Training sport-specific	Drills specific to sport including endurance training
Maintenance	Management of symptoms and prevention of flare ups	Education, continue strength training and manage loading as tolerated

Unloading a tendon weakens it over time.

Yamamoto et al 1999; Cook, Purdam 2009







Assessment

History

location of pain

reason of tendon overload

typical pain behavior

previous treatments

training tasks

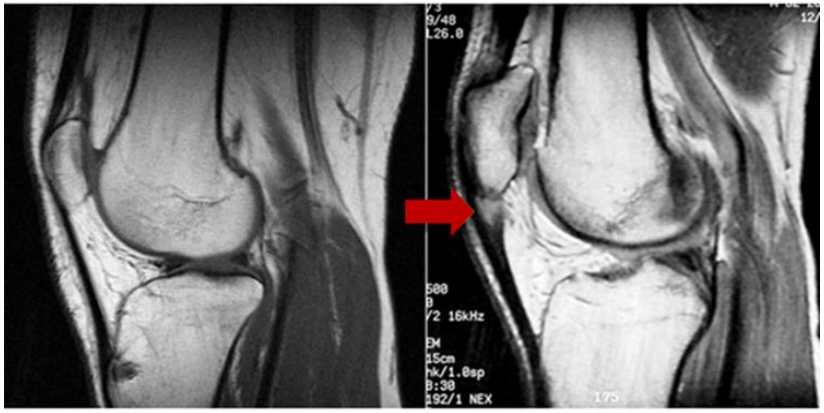
risk factors

medication

Assessment

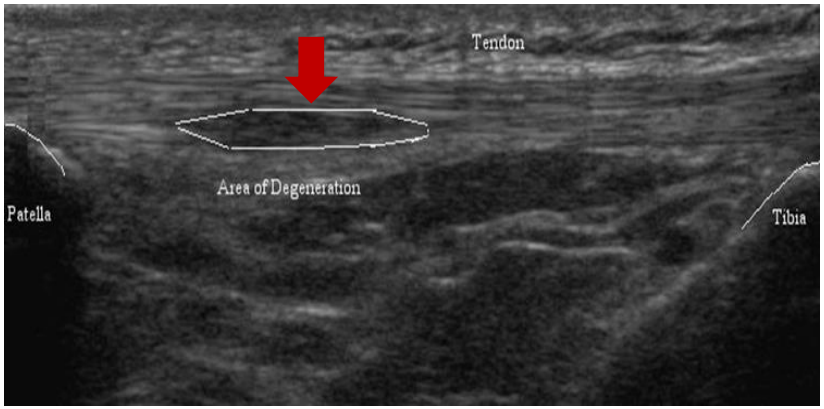
Imaging

ultrasound or magnetic resonance
often to exclude
differential diagnoses



in conventional ultrasonography

- fusiform tendon thickening,
- hypoechoic areas accompanied by disorganised tendon tissue
- increased power doppler flow



no correlation between pathology on imaging and pain

abnormal tendon imaging and pain-free function is common

helpful outcome measure

Docking SI, Daffy J, van Schie HT, Cook JL; 2012