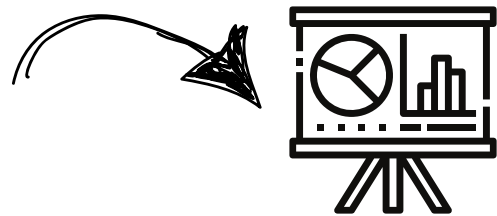




# Diagnostic and Conservative Approaches to Pathological Lesions of the Lower Limb Apophysis in Youth



Bartosz Wilczyński, PhD, PT

**State of knowledge as of October 10, 2025**

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## APOPHYSITIS AND OSTEOCHONDROSIS SITES

### ELBOW APOPHYSITIS

Little Leaguer's Elbow



### ELBOW OSTEOCHONDROSIS

Panner Disease



### HIP APOPHYSITIS

Iliac Crest

Anterior Superior Iliac Spine

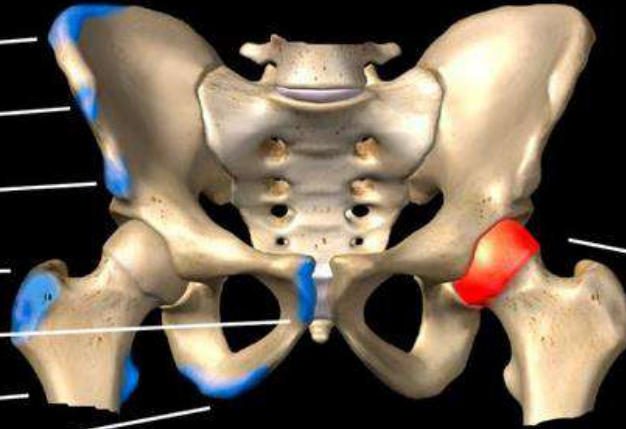
Anterior Inferior Iliac Spine

Greater Trochanter

Pubic Symphysis

Lesser Trochanter

Ischial Tuberosity



### HIP OSTEOCHONDROSIS

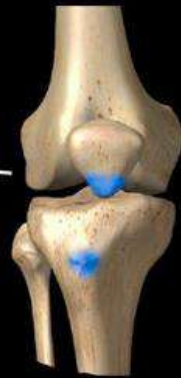
Legg-Calve Perthes Disease



### KNEE APOPHYSITIS

Larsen-Johansson Disease

Osgood-Schlatter Disease



### FOOT APOPHYSITIS

Sever Disease (achilles)

Iselin Disease



### FOOT OSTEOCHONDROSIS

Kohler Bone Disease

Freiberg Disease



FPnotebook.com



Sinding-Larson-Johansson

Osgood-Schlatters



Tibia

Fibula

Achilles tendon

Calcaneus (heel bone)

Growth plate



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# Definition and Terminology

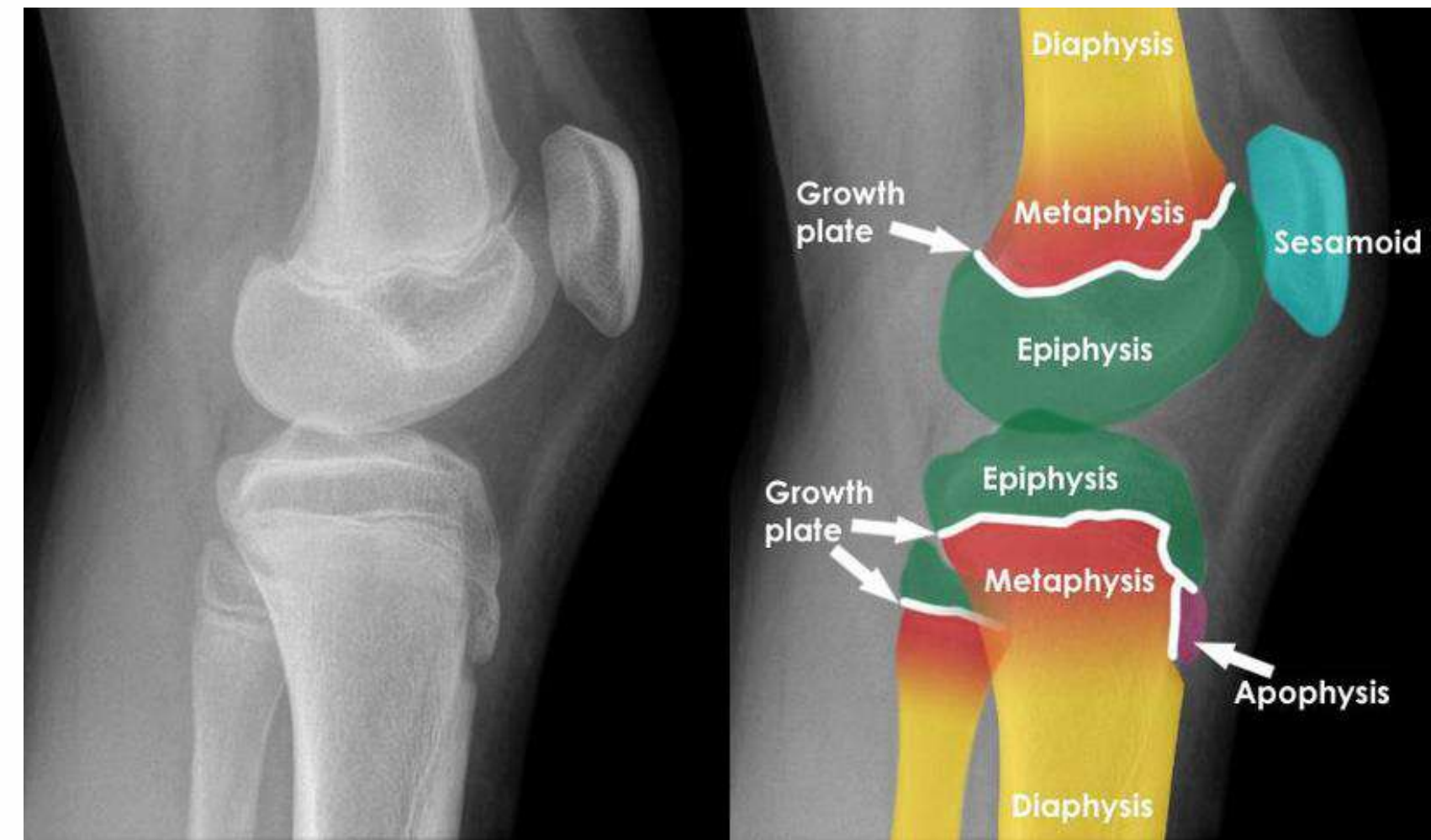
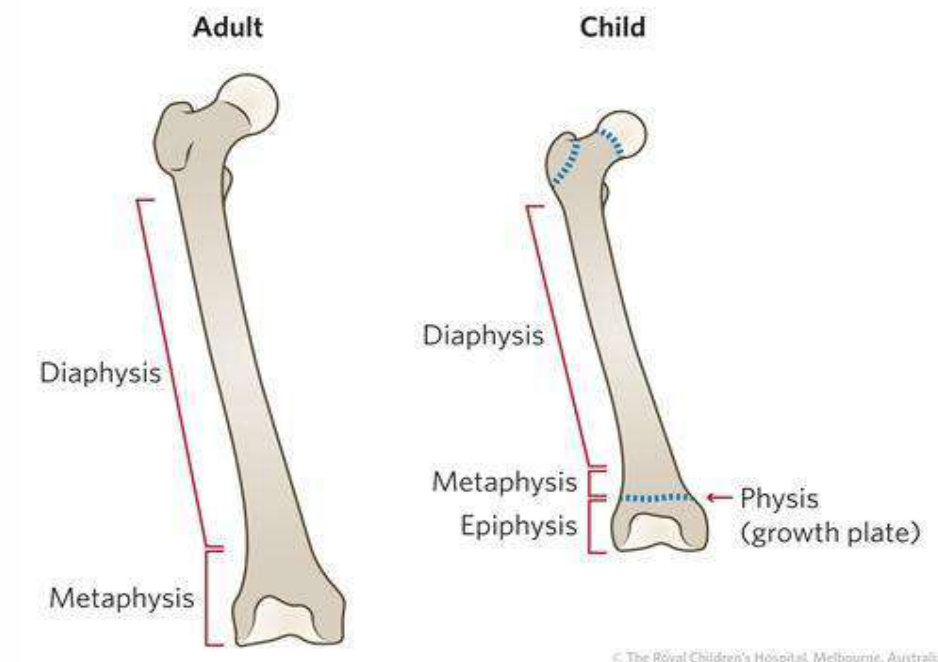
**Apophysis:** a secondary ossification center forming a bone projection (tubercle) near a joint; connected to the diaphysis/metaphysis by growth cartilage. Most fuse later with the parent bone.

Etymology:

Epiphysis → Greek epi- (“upon”) + physis (“growth”)

Apophysis → Greek apo- (“away from”) + physis (“growth”)

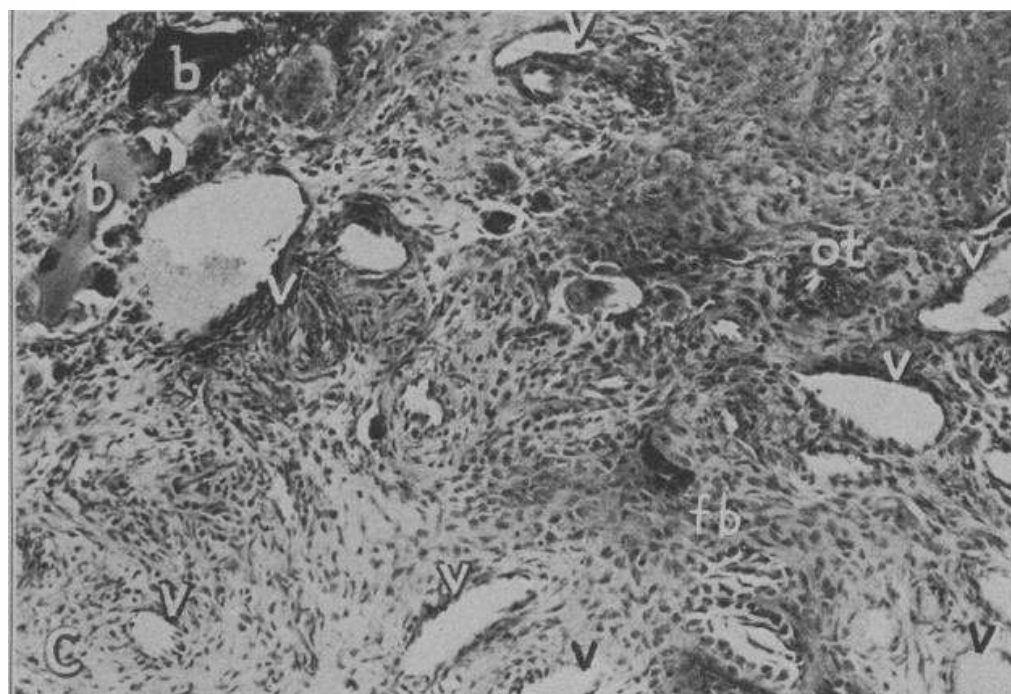
(Naňka & Bartoníček, 2024, Clinical Anatomy)



# Jałowa martwica kości...?

“the terminology and nomenclature on apophyseal injuries remain heterogeneous, and classification continues to be overlooked in applied sports medicine.”  
(Materne in Caine et al. 2025)

## OSGOOD-SCHLATTER DISEASE EDMOND UHRY JR., M.D. NEW YORK



Uhry, 1944

## THE PATHOLOGY OF TRAUMA

BY  
ALAN RICHARDS MORITZ, M.D.  
Professor of Pathology and Director of the Institute of  
Pathology of the School of Medicine of Western  
Reserve University, Cleveland, Ohio

*Spontaneous Aseptic Necrosis.*—Spontaneous aseptic necrosis occurs most frequently in the epiphyses of growing bones, but may be encountered in adults. Its various clinical forms have been named in most instances after the men who first described the syndrome peculiar to the particular anatomical site of the lesion. Thus, aseptic necrosis of the calcaneus has been named after Haglund; of the clavicle after Friedrich; of the femur after Legg, Calvé, or Perthes; of the capitellum after Panner and humeral head after Hass; of the metatarsals, first after Wagner, second after Freiberg or Köhler, and fifth after Iselin; of the patella after Larsen or Johansson; of the scaphoid after Köhler; of the semilunar after Kienbock; of the sesamoids after Renander or Müller; and the tibial tubercle after Osgood or Schlatter. Other designations of the disease include osteochondritis, epiphysitis, osteochondropathy, osteomyelitis, and osteomalacia. Localized subchondral necrosis with sequestration and dislodgment of the dead bone into the joint space

Moritz, 1954

# Sterile Osteonecrosis...?



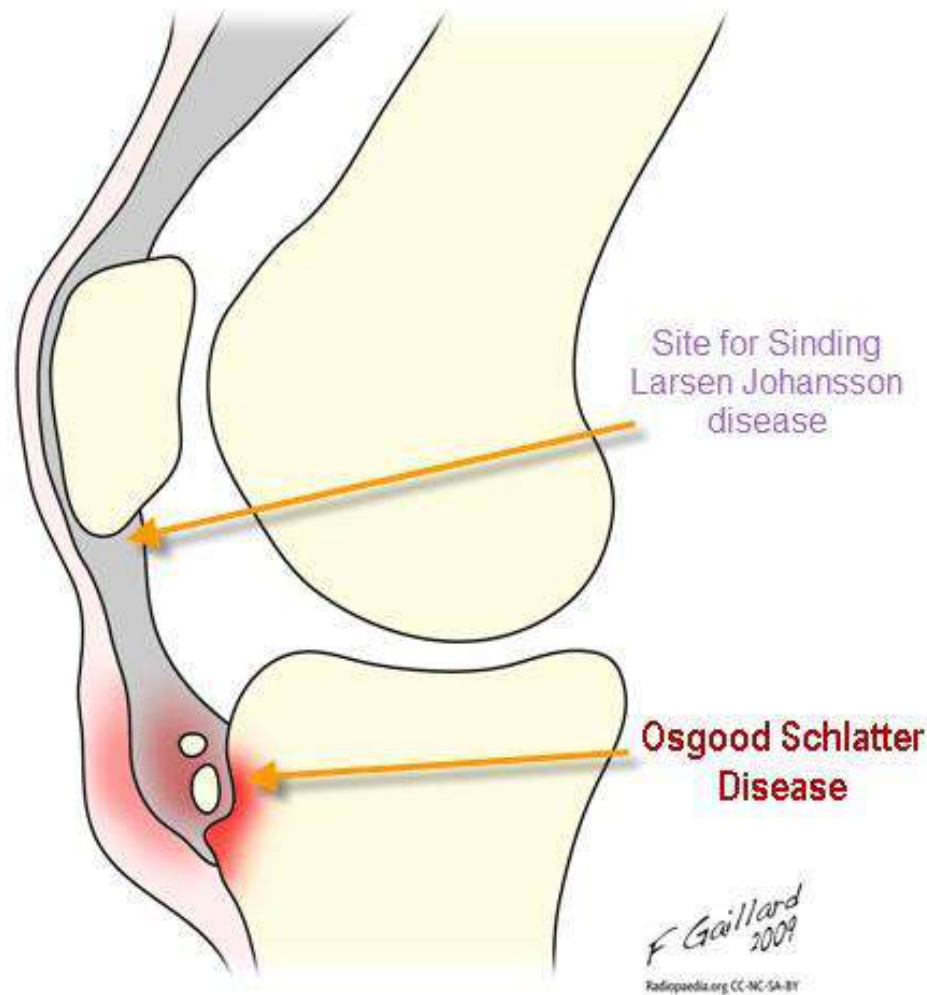
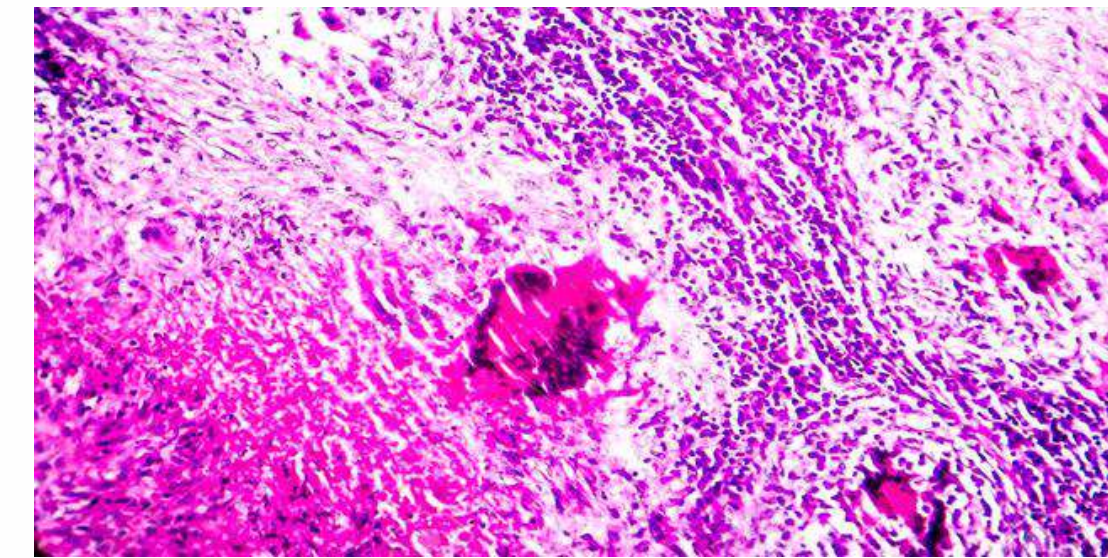
Terminology Matters: Bridging Gaps in Medical Communication with Osgood-Schlatter Lesions and Sterile Osteonecrosis (Wilczyński & Zorena 2025, in review)



# The overlooked scientific debate of the 1950s–60s?

~~Jałowa martwica kości...~~

~~Sterile Osteonecrosis...~~

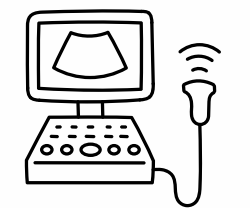
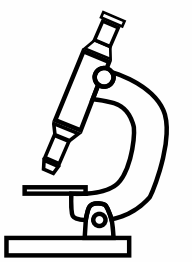


Cohen & Wilkinson (1958): No necrotic or vascular pathology found in examined bone tissue.

Rapp & Lazerte (1958): No bone necrosis or degeneration in the tibial tuberosity apophysis; small necrotic areas in ossicles were considered normal findings after avulsion.

Czyrny & Greenspan (2009, 2011): Reported that “necrotic” features in the tendon are in fact ectopic calcifications; thus, classifying OSD as osteochondritis or bone necrosis is incorrect.

Cole(1937), Ogden & Southwick (1976): Good vascularization of the tibial tuberosity, in patients with avulsion of the developing ossification center



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## Consequences of Incorrect Terminology

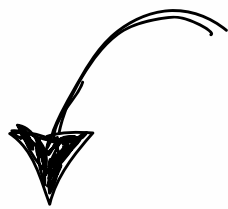
martwice jałowe kości

Encyklopedia PWN

**martwice jałowe kości**, med. zespoły chorobowe powstające w wyniku obumarcia tkanki kostnej oraz częściowo tkanki chrzęstnej bez udziału drobnoustrojów chorobotwórczych;

dotyczą najczęściej nasad szybko rosnących kości; występuje wiele postaci martwic jałowych kości, najczęściej pojawiające się to: **choroba Blounta** (martwica jałowa przyśrodkowego kłykcia piszczeli), **choroba Calvégo** (martwica jałowa trzonu kręgu), **choroba Haglunda** (martwica jałowa guza piętowego), **choroba Osgooda–Schlattera** (guzowatość piszczeli), **choroba Scheuermanna** (martwica jałowa nasad trzonów kręgowych); leczenie polega na odbarczaniu chorych kości, także operacyjne.

The term “aseptic bone necrosis/osteonecrosis” may be misinterpreted by patients and parents as irreversible bone death or permanent damage.



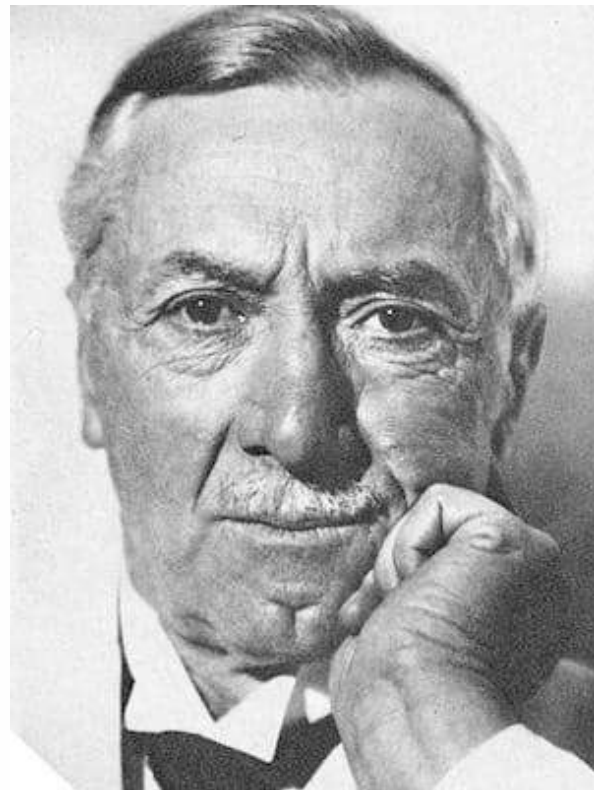
Leads to passive “wait and see” approach → No EBM support → Still used by ~25% of practitioners (Holden & Rathleff, 2020)



# Osgood-Schlatter, Sinding-Larsen-Johansson, Sever's "disease"

Osgood Schlatter (and other apophyseal injuries) is not due to underlying disease and has restorative features, (Cohen & Wilkinson, 1958)

Morbus? or maybe lesion?  
or Apophyseal Physal Stress Injury  
(Materne in Caine et al. 2024)



Verletzungen des schnabelförmigen Fortsatzes der oberen Tibiaepiphyse.  
Von  
Prof. Dr. Carl Schlatter.



LESIONS OF THE TIBIAL TUBERCLE OCCURRING DURING ADOLESCENCE.  
BY ROBERT B. OSGOOD, M.D., BOSTON.



A Hitherto Unknown Affection of the Patella  
in Children

by  
Chr. M. F. Sinding-Larsen, M. D., Kristiania



APOPHYSITIS OF THE OS CALCIS.  
BY JAMES WARREN SEVER, M. D.,  
Boston,  
Junior Assistant Surgeon, Children's Hospital, Boston.

Bayomy AF, Forrester LA, Crowley SG, Popkin CA. Eponyms in Pediatric Sports Medicine: A Historical Review. Open Access J Sports Med. 2021;12:11-22

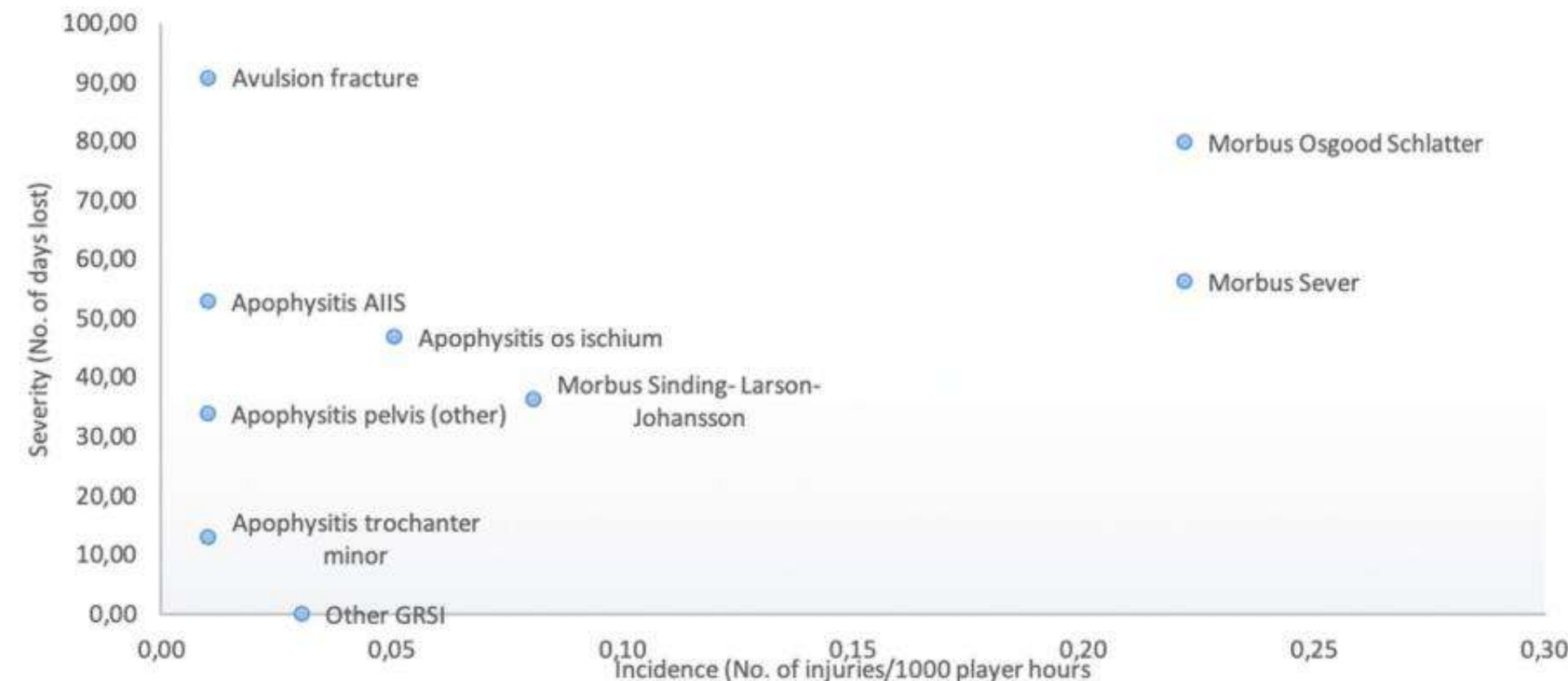


# Epidemiology

## Comparison of Apophyseal Injuries in Youth Football

The overall reinjury rate in this study was almost 21%

| Injury                   | Incidence (/1000 h) | Mean Time-Loss (days) | Injury Burden (days/1000 h) |
|--------------------------|---------------------|-----------------------|-----------------------------|
| Osgood-Schlatter         | 0.22                | 80.1                  | 17.6                        |
| Sever                    | 0.22                | 56.5                  | 12.4                        |
| Sinding-Larsen-Johansson | 0.08                | 36.4                  | 2.9                         |
| Ischial Apophysitis      | 0.05                | 47.0                  | 2.4                         |



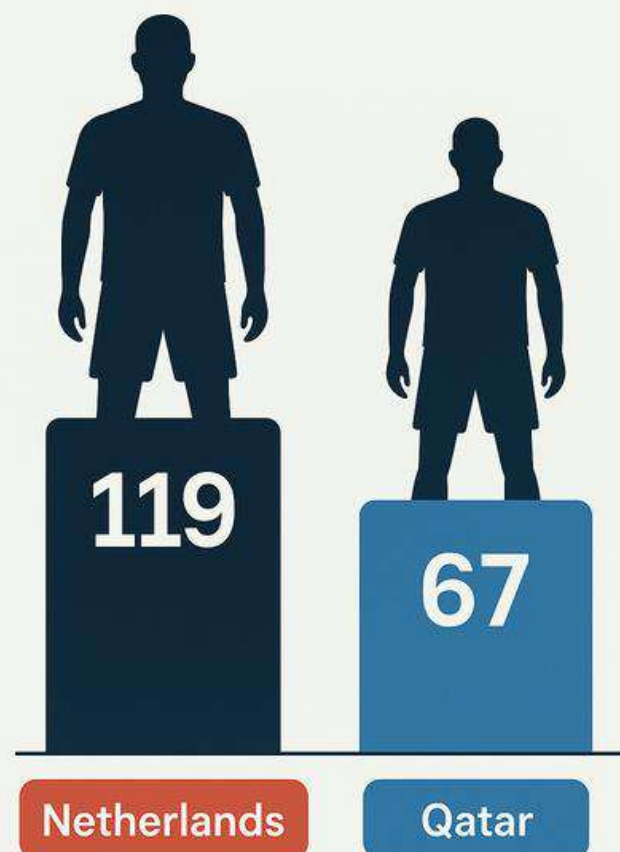
## Growth-related sports injuries among young male professional football players in the Netherlands: a prospective cohort study concerning injury incidence, severity and burden

Else E. A. E. Juch, Vincent C. van de Koppel, Donna Blokland<sup>a</sup>, Renko A. Wouters<sup>a</sup>, Frank J. G. Backx<sup>a</sup>, Edwin A. Goedhart<sup>b</sup> and Nick van der Horst<sup>id</sup>

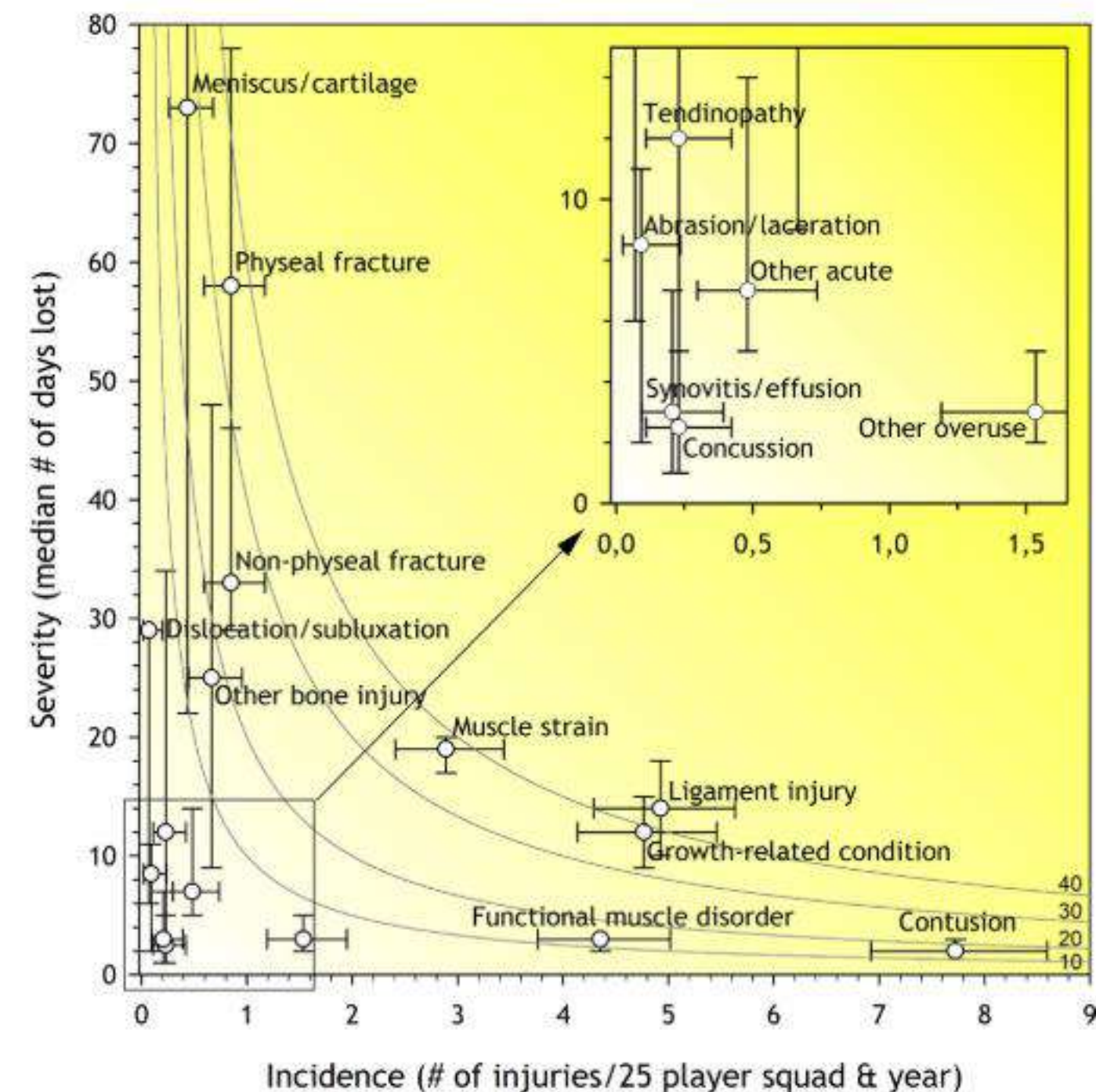
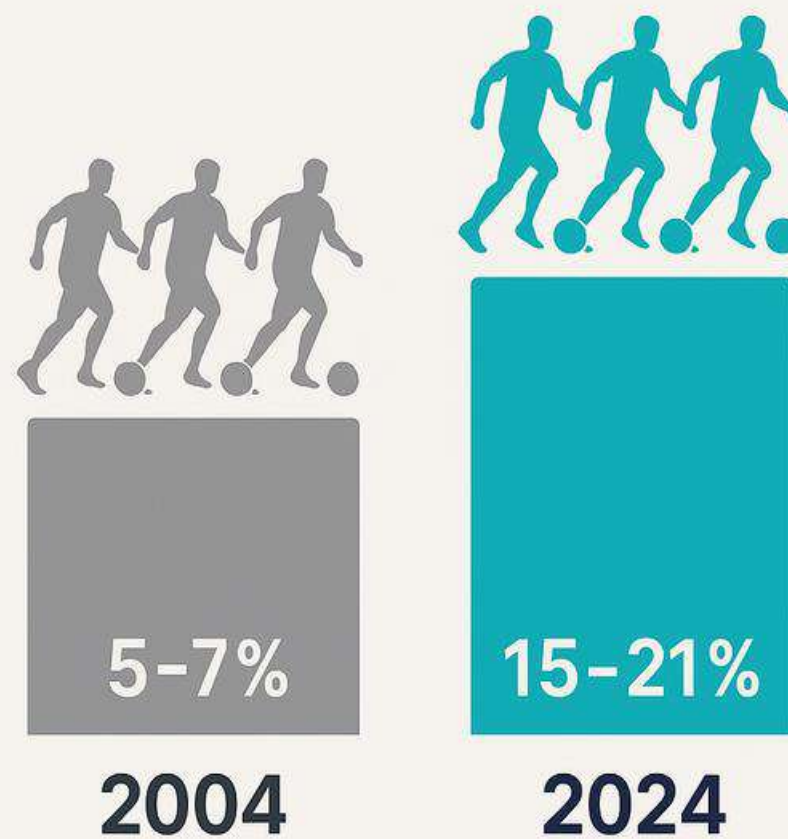




Reported a burden of 119 days (Netherlands) and 67 days (Qatar) per squad (25 players) per season, respectively.



Three-fold increase in prevalence of time-loss from apophyseal injuries during the last 20 years



Materne et al. 2021, Gudelis et al. 2022, Sato et al. 2024, La Gall et al. 2006, Holtus et al. 2023, Materne et al. 2022



# Are Apophyseal Injuries Self-Limiting and Resolved After Growth Spurt?

Textbooks, clinician surveys, and narrative reviews describe these conditions as **benign, self-limiting, and confined to the growth-spurt years**

(Ladenhauf et al., 2020; Cerci et al., 2017; Khan & Brukner, 2019)



## Long-term functional and sonographic outcomes in Osgood–Schlatter disease

Derya Ozer Kaya · Ugur Toprak · Gul Baltaci ·  
Baran Yosmaoglu · Hamza Ozer

## Is the Prognosis of Osgood-Schlatter Poorer Than Anticipated?

### A Prospective Cohort Study With 24-Month Follow-up

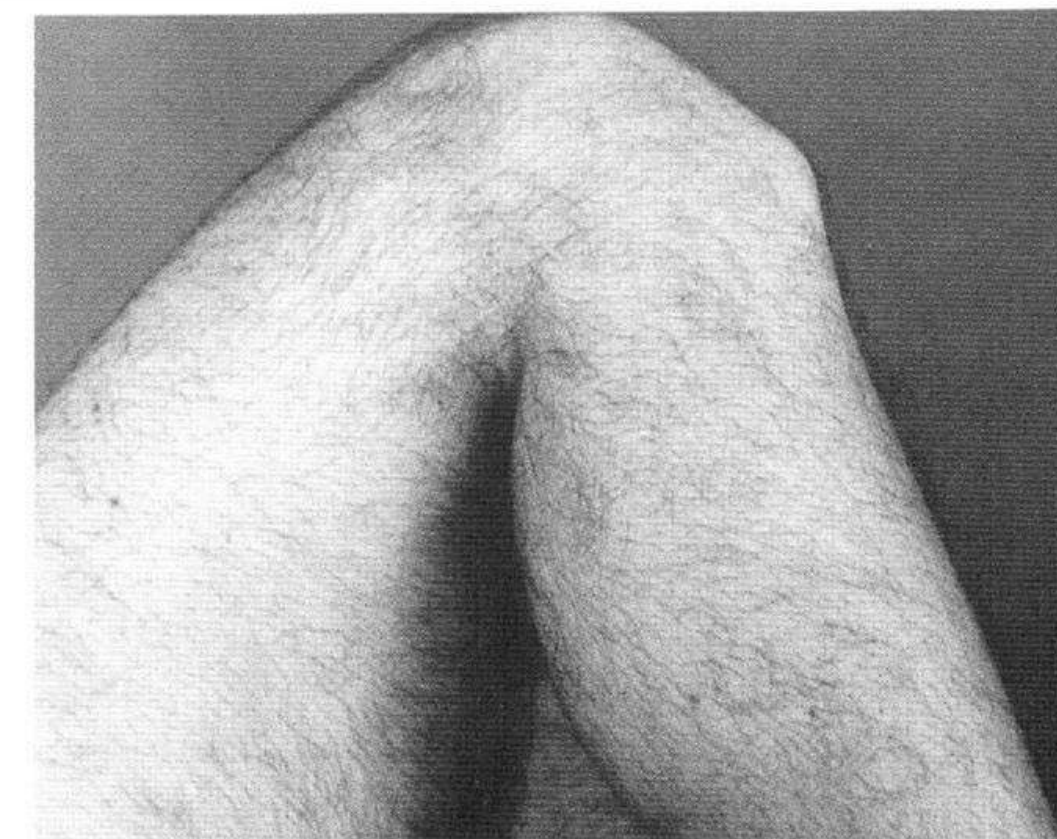
Sinead Holden,<sup>\*††</sup> PhD, Jens Lykkegaard Olesen,<sup>‡§</sup> PhD, Lukasz M. Winiarski,<sup>||</sup> MSc, Kasper Krommes,<sup>‡||</sup> MSc, Kristian Thorborg,<sup>¶</sup> PhD, Per Hölmich,<sup>¶</sup> DM, and Michael Skovdal Rathleff,<sup>†||</sup> PhD

## Long-term Prognosis and Impact of Osgood-Schlatter Disease 4 Years After Diagnosis

### A Retrospective Study

Clara Guldhammer,<sup>\*</sup> BSc(Med), Michael Skovdal Rathleff,<sup>\*</sup> PhD, Hans Peter Jensen,<sup>†‡</sup> MD, and Sinead Holden,<sup>\*</sup> PhD

- Guldhammer et al. (2019): >50% of participants still reported knee pain 4 years after diagnosis; OSD linked to lasting effects on function and quality of life.
- Kaya et al. (2013): After 2 years, only ~50% fully recovered; tendon structure normalized, but endurance, power, and strength remained below healthy peers.
- Ross & Villard (2003), Holden et al. (2020): chronic knee pain, tendon morphology changes, reduced sports participation, and impaired strength and endurance .

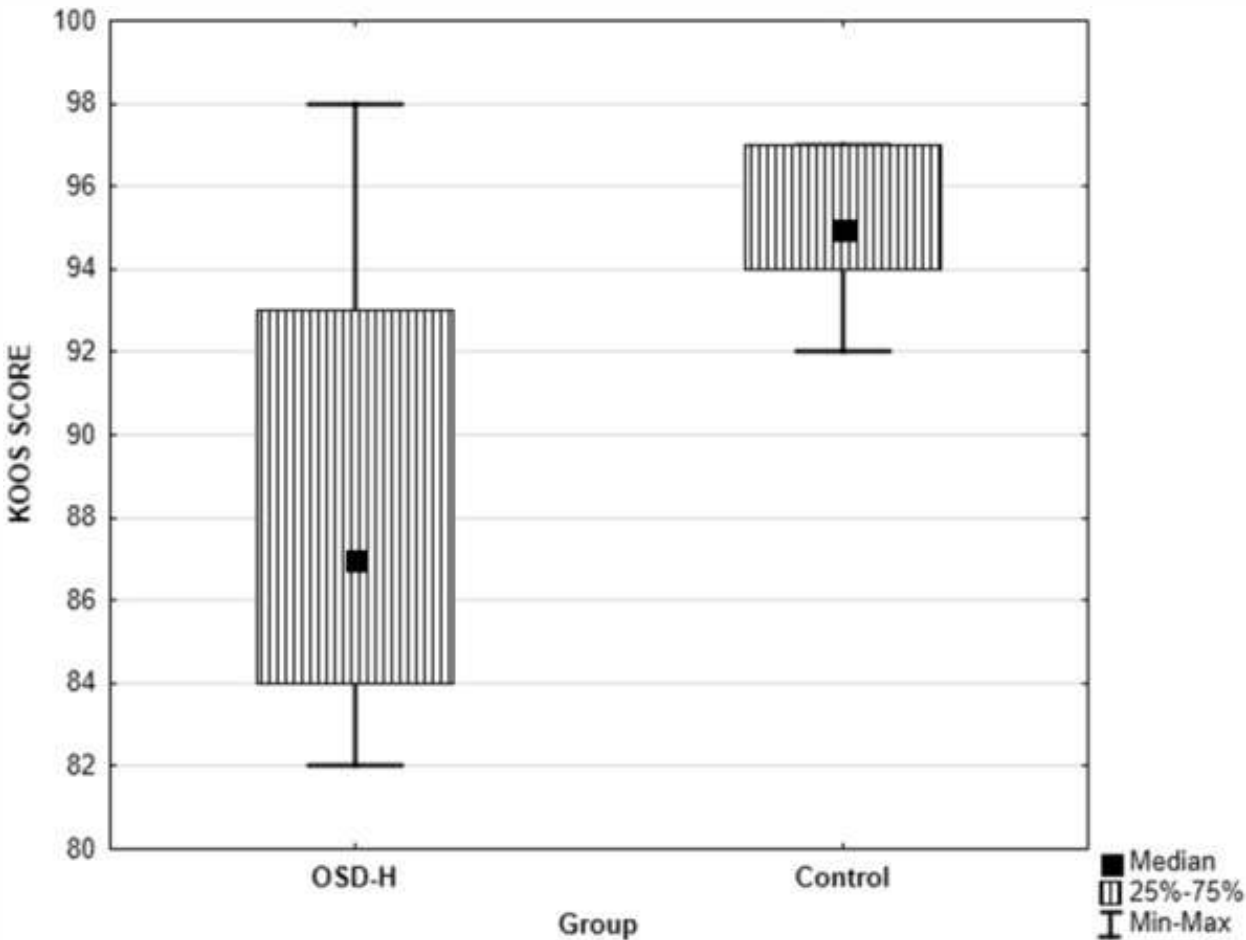


**FIG. 1.** Prominent tibial tuberosity at review. Male patient, aged 26 years with 11-year follow-up.



OPEN Knee function and quality of life in adolescent soccer players with Osgood Shlatter disease history: a preliminary study

Rafał Bruzda<sup>1,3</sup>, Bartosz Wilczyński<sup>2,3</sup> & Katarzyna Zorena<sup>2,3</sup>



| Variables (median (IQR)) | OSD-H (n = 9) | Control (n = 9) | p between groups | p between variables |
|--------------------------|---------------|-----------------|------------------|---------------------|
| Ely's test, L (°)        | 121.0 (6.0)   | 120.0 (7.0)     | 0.270            | 0.349               |
| Ely's test, R (°)        | 125.0 (3.0)   | 118.0 (10.0)    | 0.200            |                     |
| WBLT, L (cm)             | 10.0 (4.5)    | 10.0 (3.0)      | 0.724            | 0.690               |
| WBLT, R (cm)             | 11.00 (2.5)   | 10.0 (0.0)      | 0.452            |                     |
| Leg Press, L (W)         | 958.0 (285.0) | 932.0 (213.0)   | 0.427            | 0.163               |
| Leg Press, R (W)         | 948.0 (320.0) | 898.0 (175.0)   | 0.480            |                     |
| SLHD, L (cm)             | 180.0 (7.0)   | 173.0 (23.0)    | 0.289            | 0.695               |
| SLHD, P (cm)             | 183.0 (12.0)  | 168.0 (17.0)    | 0.085            |                     |
| SLCMJ, L (cm)            | 22.5 (2.4)    | 23.0 (2.1)      | 0.860            | 0.542               |
| SLCMJ, P (cm)            | 23.6 (2.5)    | 24.0 (1.1)      | 0.791            |                     |



Supplementary Figure 5. Single Leg Hop for Distance. Start and end position of the test.



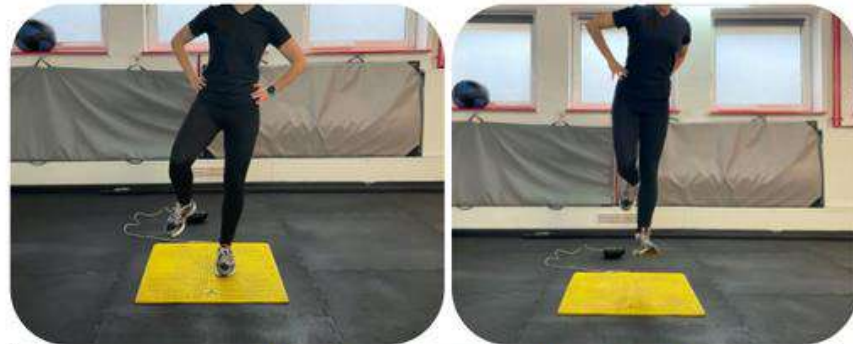
Supplementary Figure 1. Ely's test. Start (knee full extension) and end position (knee maximally flexed) of the test.



Supplementary Figure 2. WBLT test. End position (furthest point of the foot from the wall) of the test.

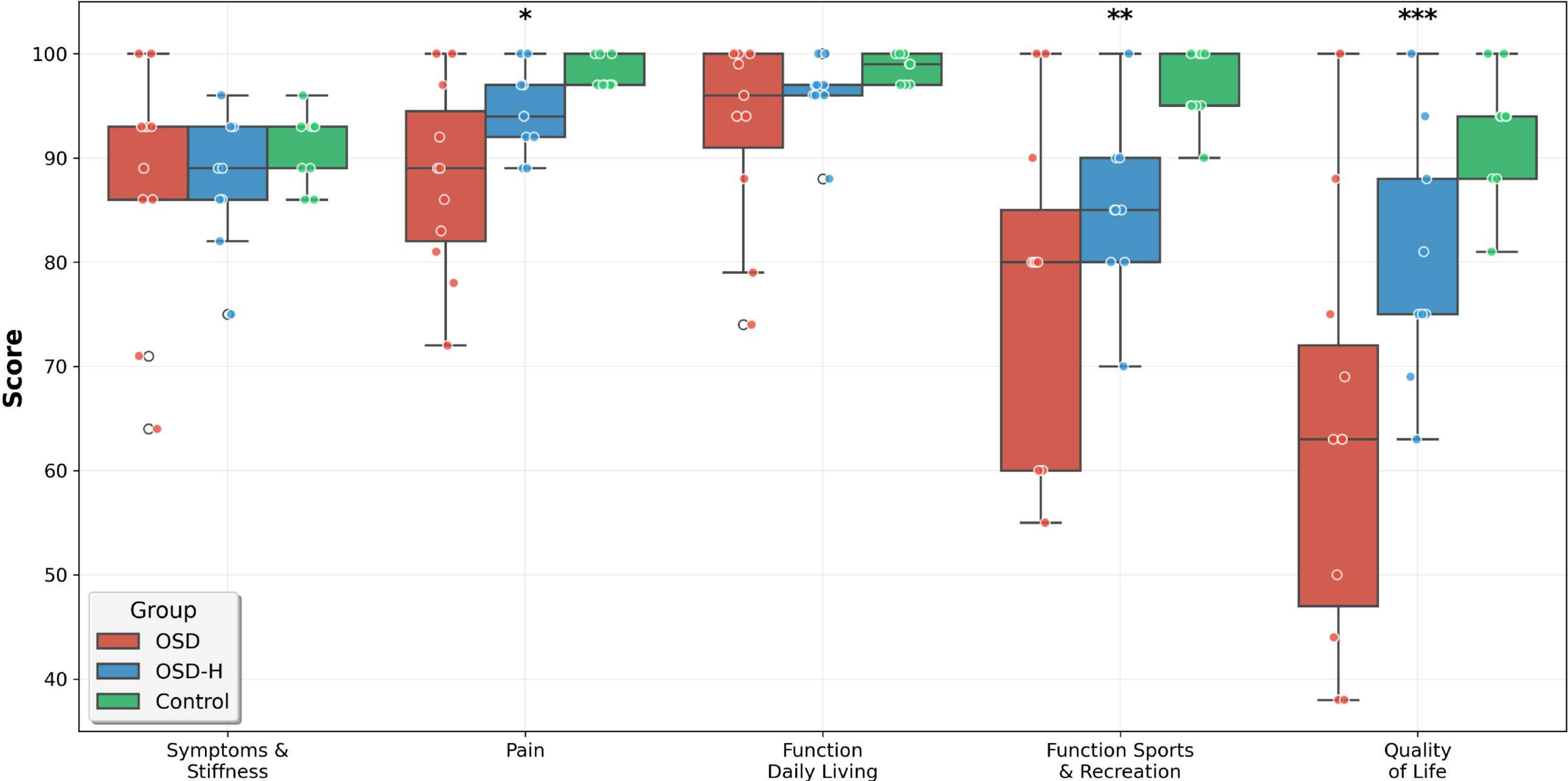


Supplementary Figure 3. Leg Press test (Keiser Air420 air crane). Start and end position (left knee extension) of the test.



Supplementary Figure 4. Single Leg Countermovement Jump. Start and mid position (jumping off moment) of the test.

# KOOS Subscale Scores by Group

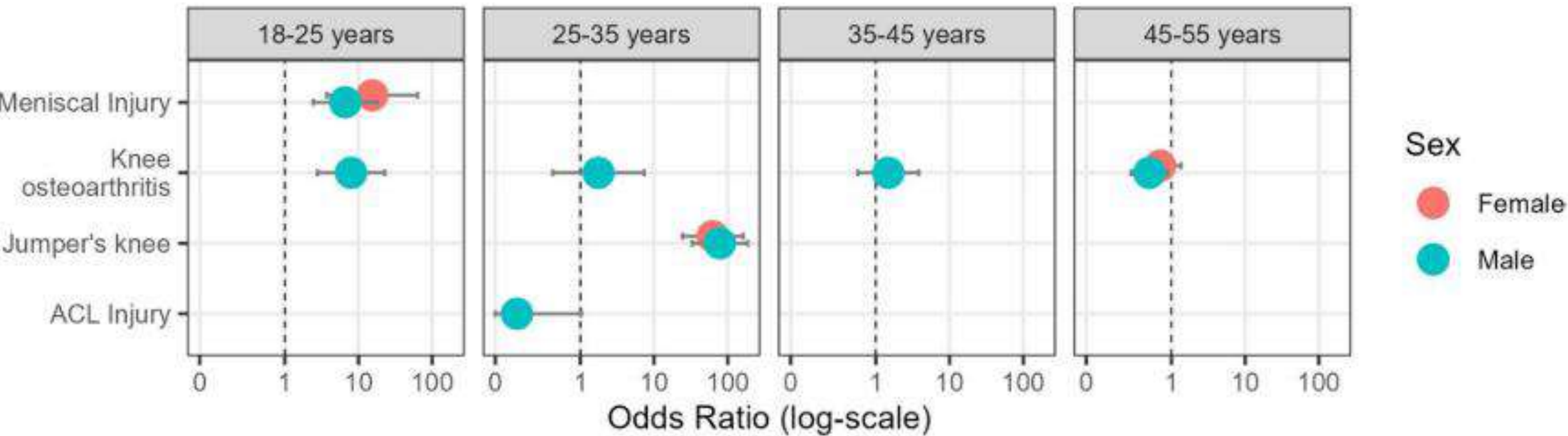


Wilczyński et al. (not published anywhere)

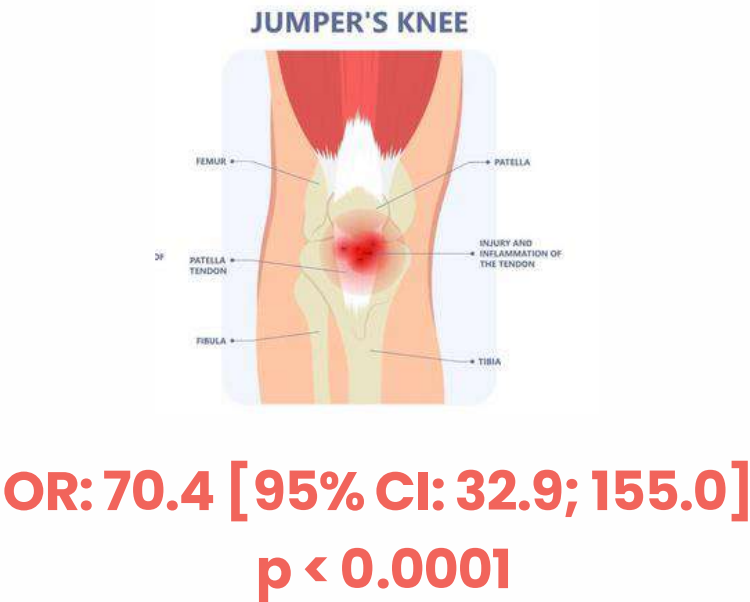
ORIGINAL RESEARCH ARTICLE

Long-Term Knee Health in Adults with a History of Adolescent Osgood–Schlatter: A National Cohort Study of Patients in Secondary Care in Denmark 1977–2020

Kasper Krommes<sup>1</sup> · Amalie Bjerre<sup>1,2</sup> · Kristian Thorborg<sup>1,3</sup> · Mathias Fabricius Nielsen<sup>1</sup> · Per Hölmich<sup>1,3</sup>

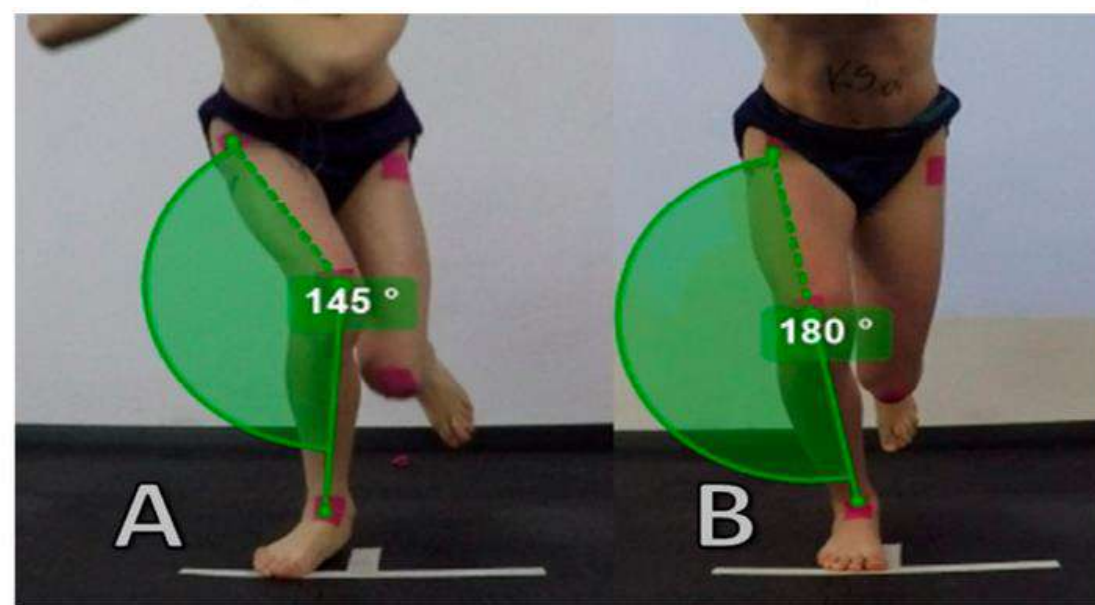
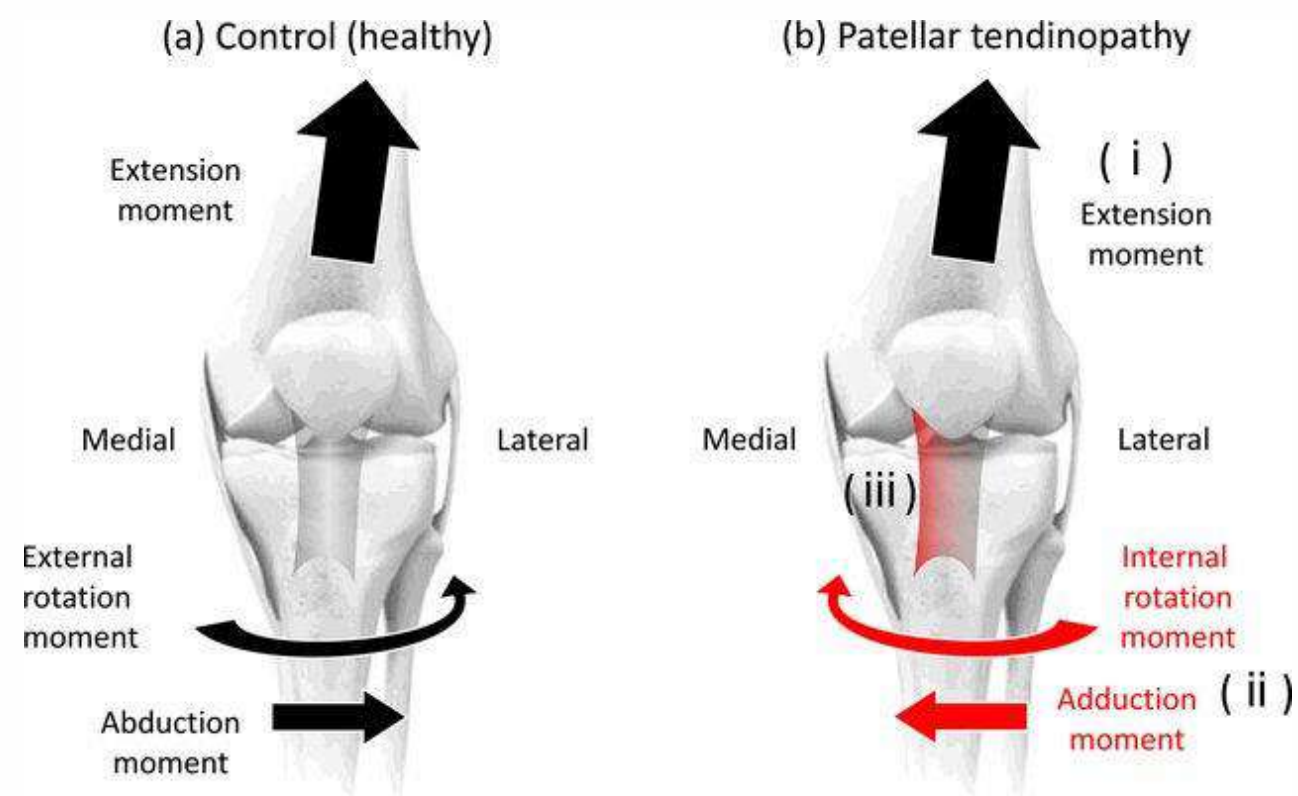


- 85% still have a visible tibial tubercle bump
- 73% report ongoing pain/problems at the same site
- KOOS scores significantly lower vs. healthy peers (all subscales,  $p < 0.05$ ,  $d > 0.8$ )
- Long symptom duration and high pain during adolescence → worse adult outcomes



→ OSD is not as benign or self-limiting as once believed

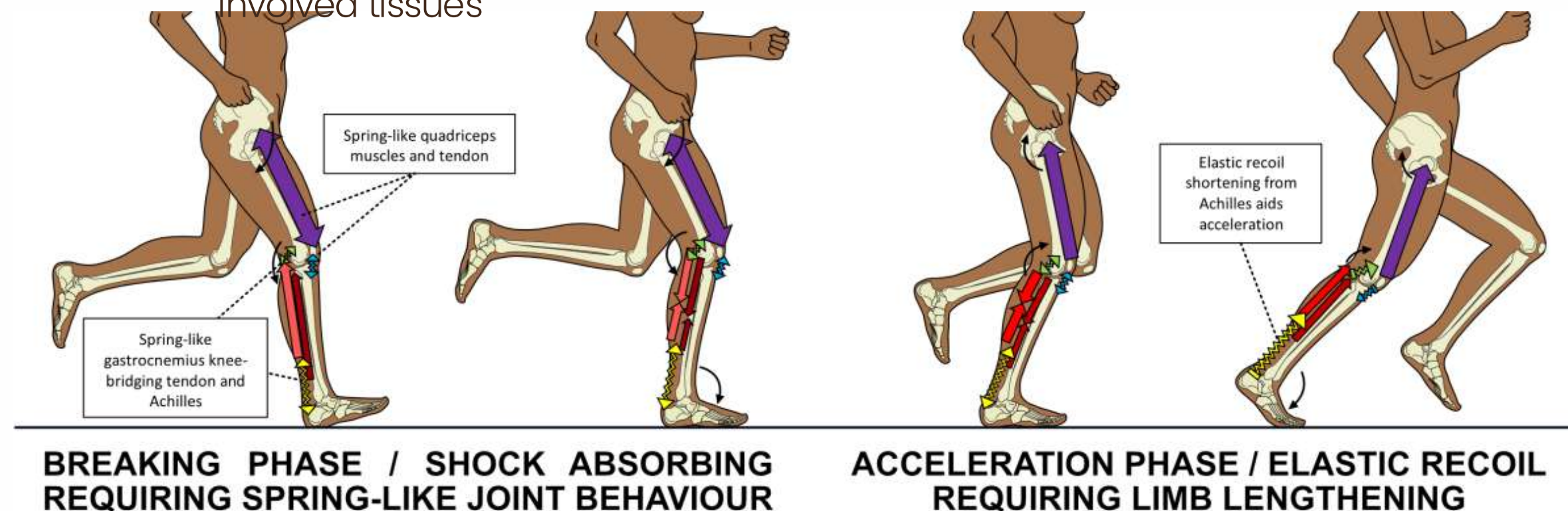




Wilczyński et al. 2020, Wilczyński et al. 2021, Obara et al. 2022

# Traction mechanism and...?

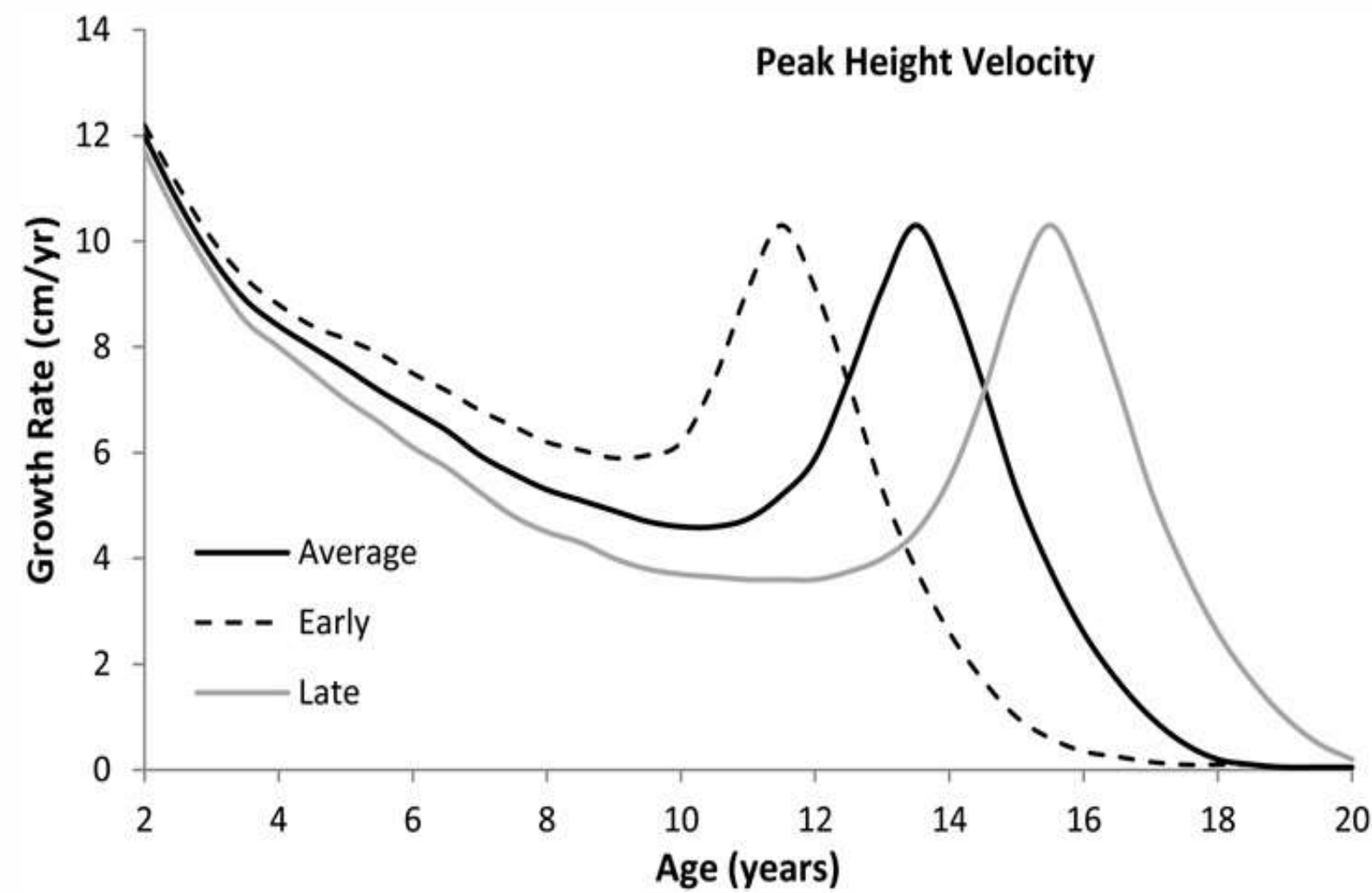
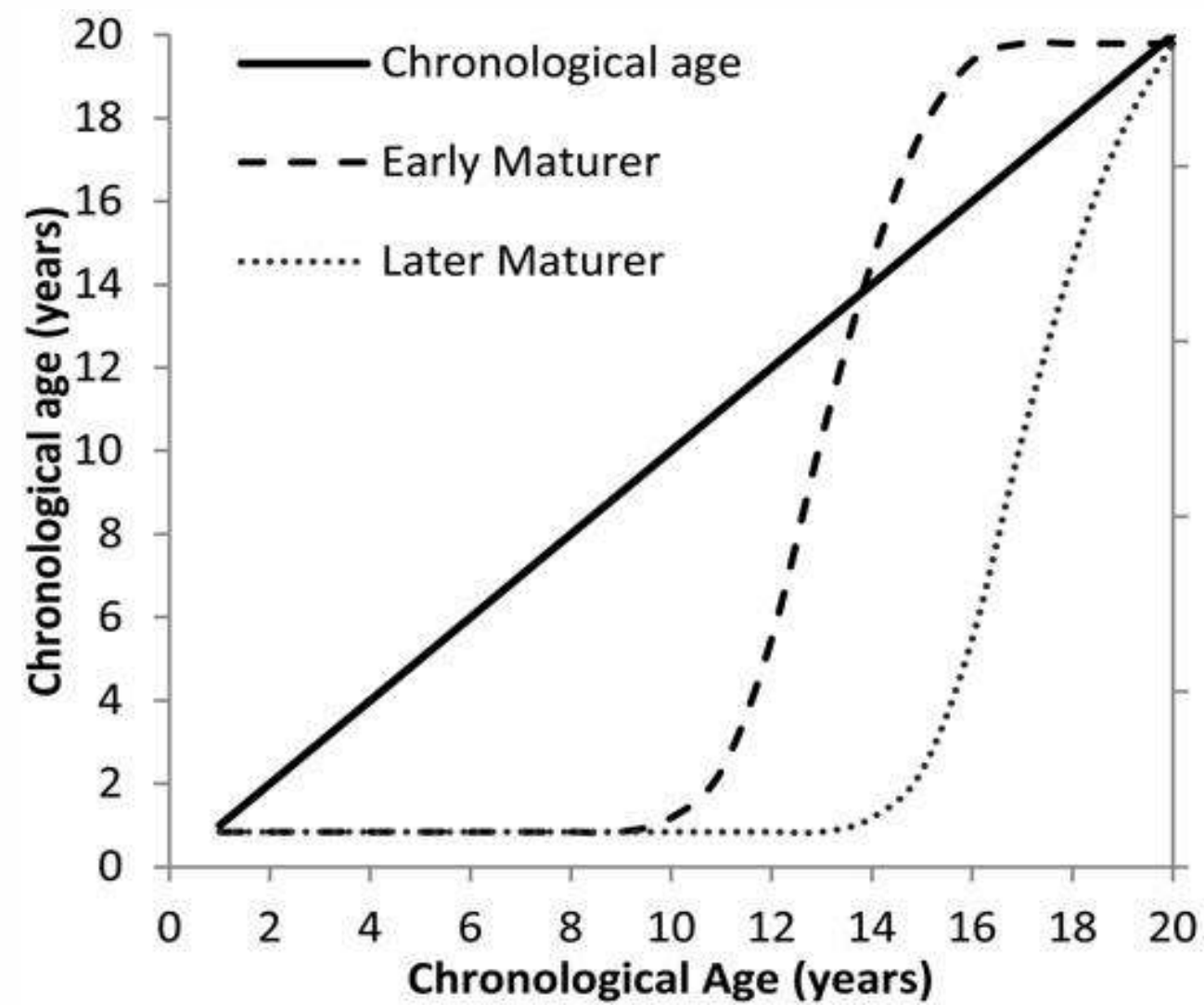
The current understanding of the pathogenesis is that ongoing traction and tensile loading from the major load-bearing tendon on the secondary ossification center make the tendon–bone interface more prone to micro-avulsions and irritation of the involved tissues



The endochondral ossification phase is the most vulnerable period to repetitive stress.

Bone growth and maturation progress distal → proximal, aligning with PHV timing.

# The role of maturation and bone growth



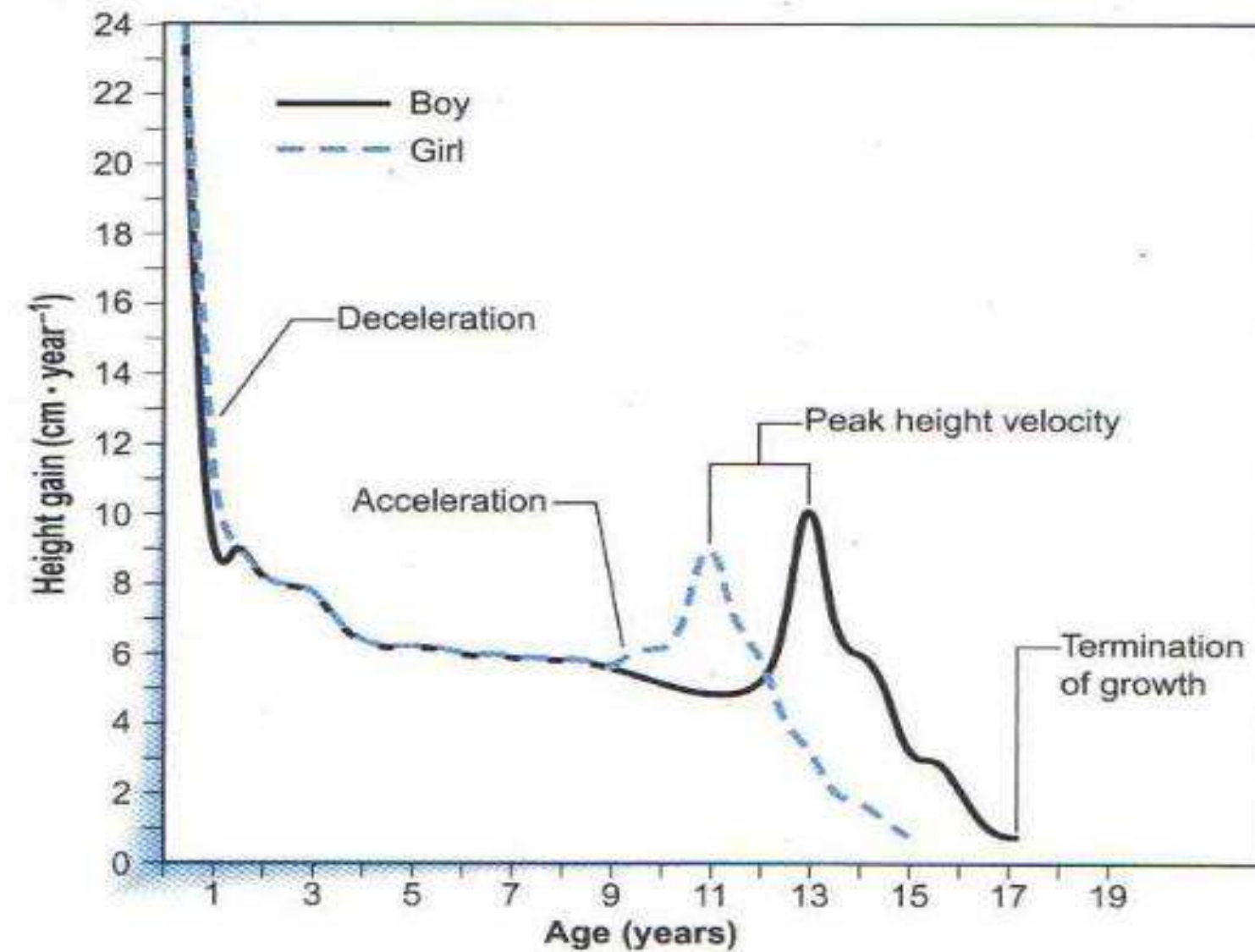
The endochondral ossification phase is the most vulnerable period to repetitive stress.

Bone growth and maturation progress distal → proximal, aligning with PHV timing.

## The role of maturation and bone growth

Late-maturing players: higher incidence of lower-limb apophyseal injuries, especially OSD.

Early-maturing players: more hip and pelvic apophyseal injuries (AIIIS, pubic bone, lesser trochanter).



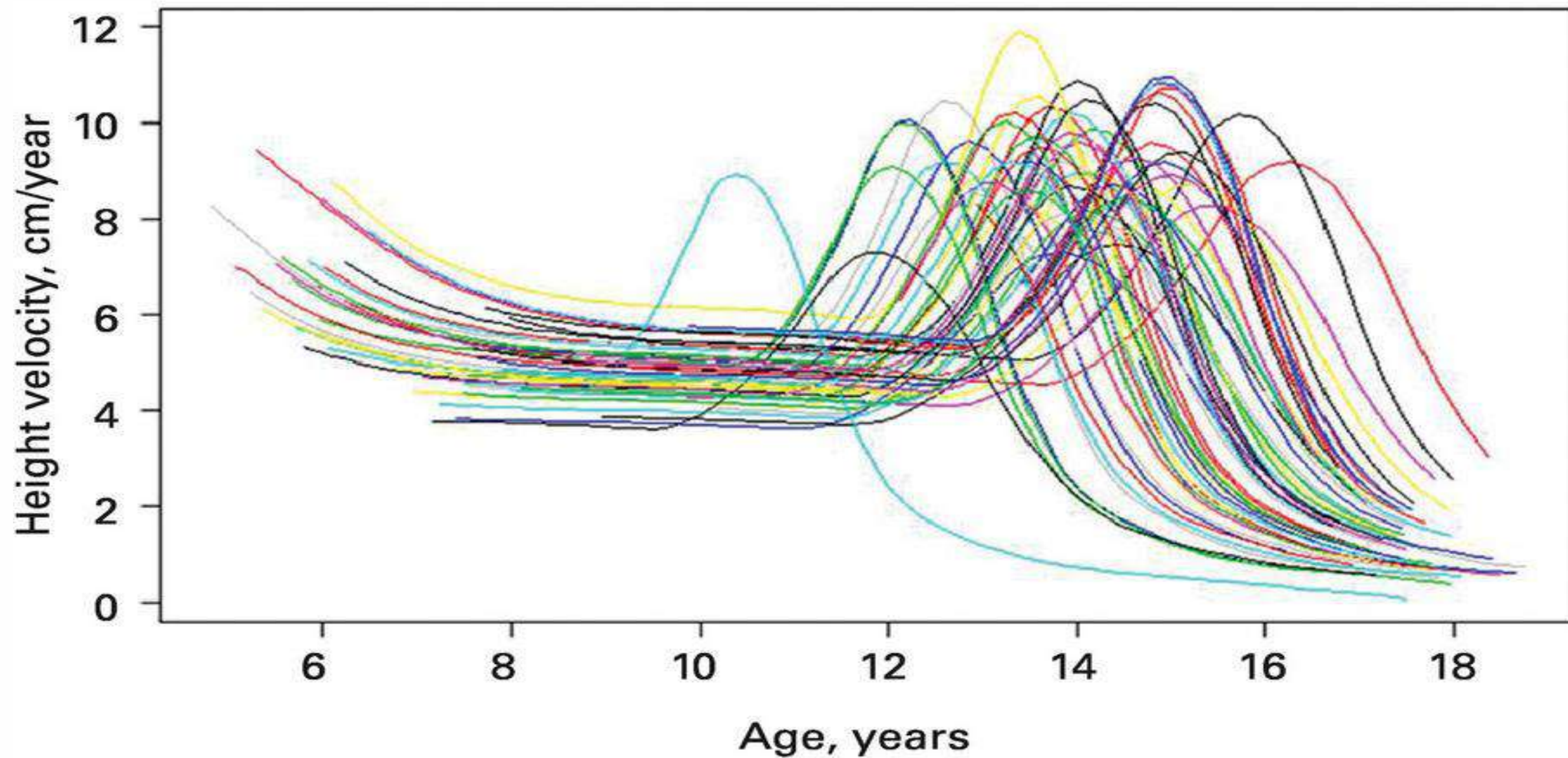
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# The role of maturation and bone growth



# How to diagnose it?



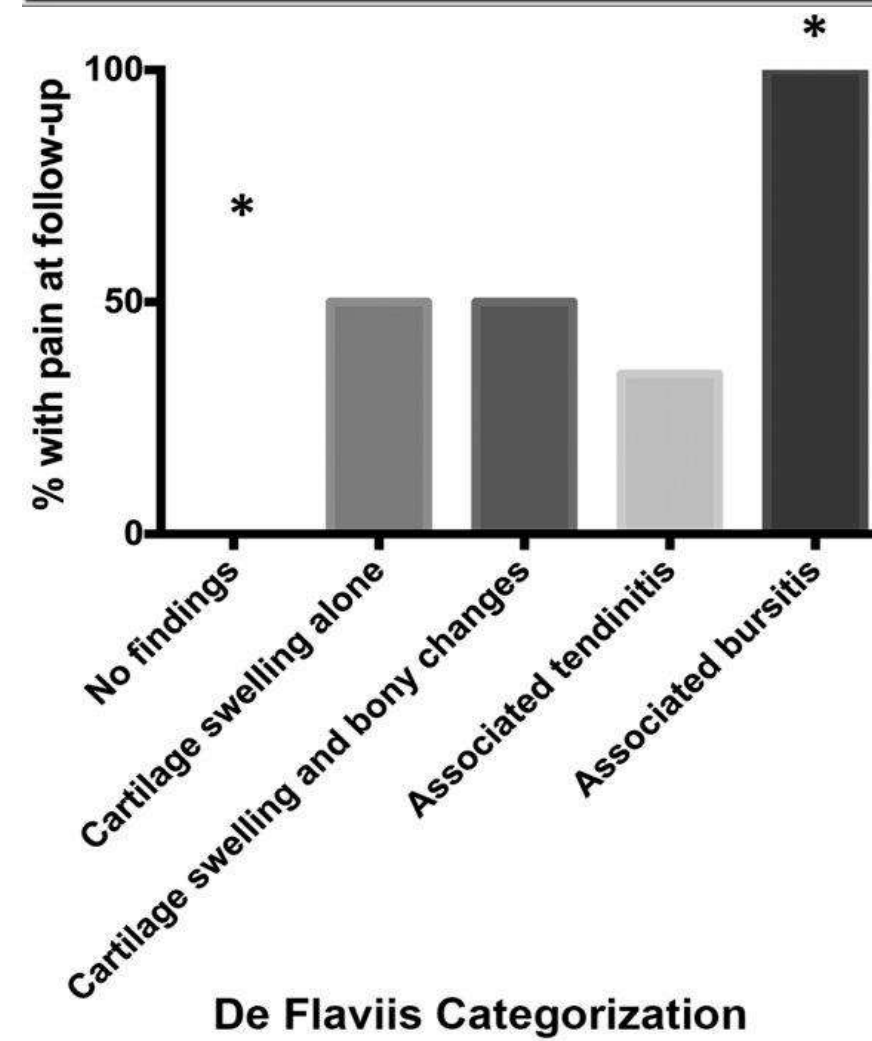
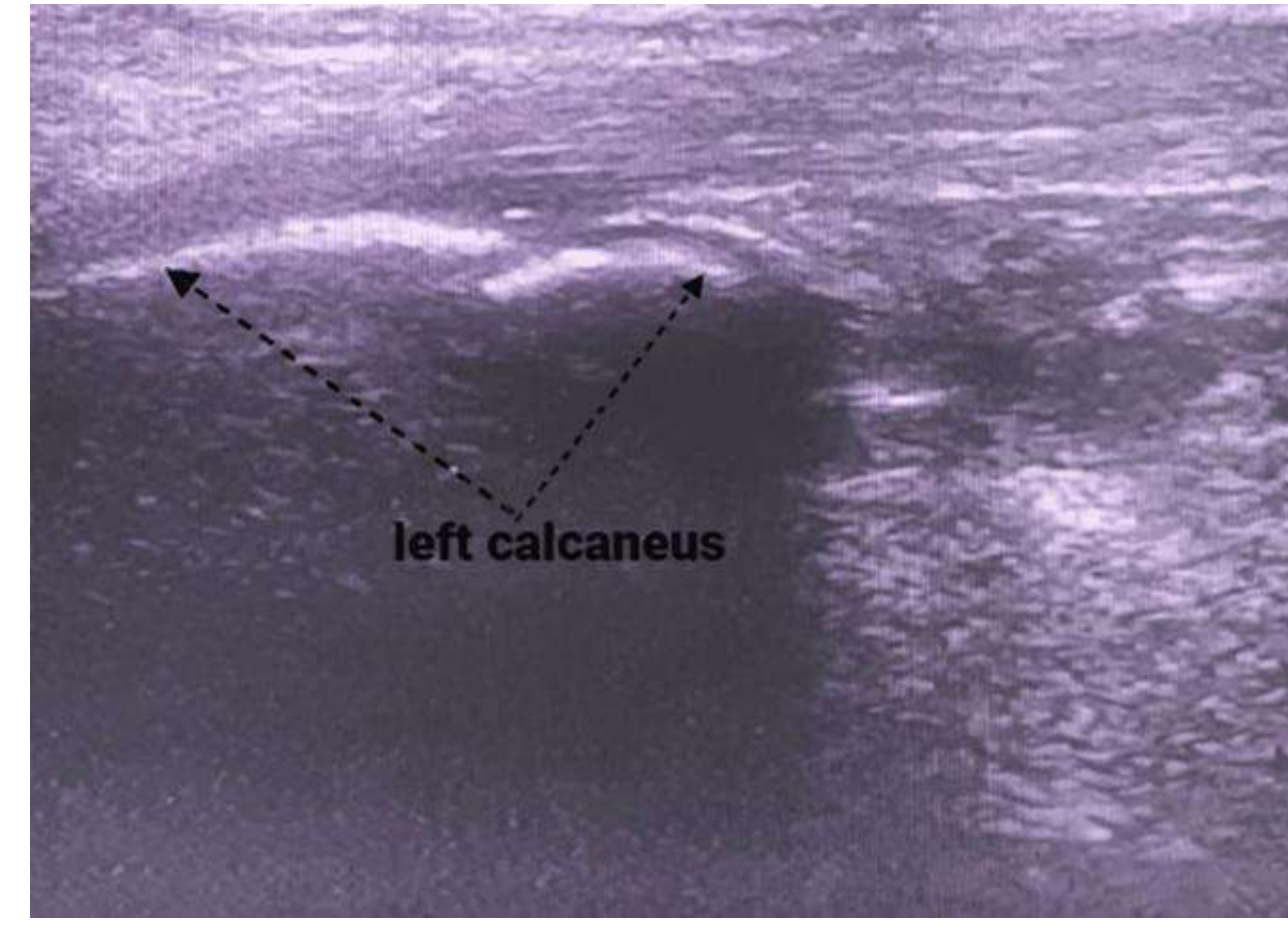
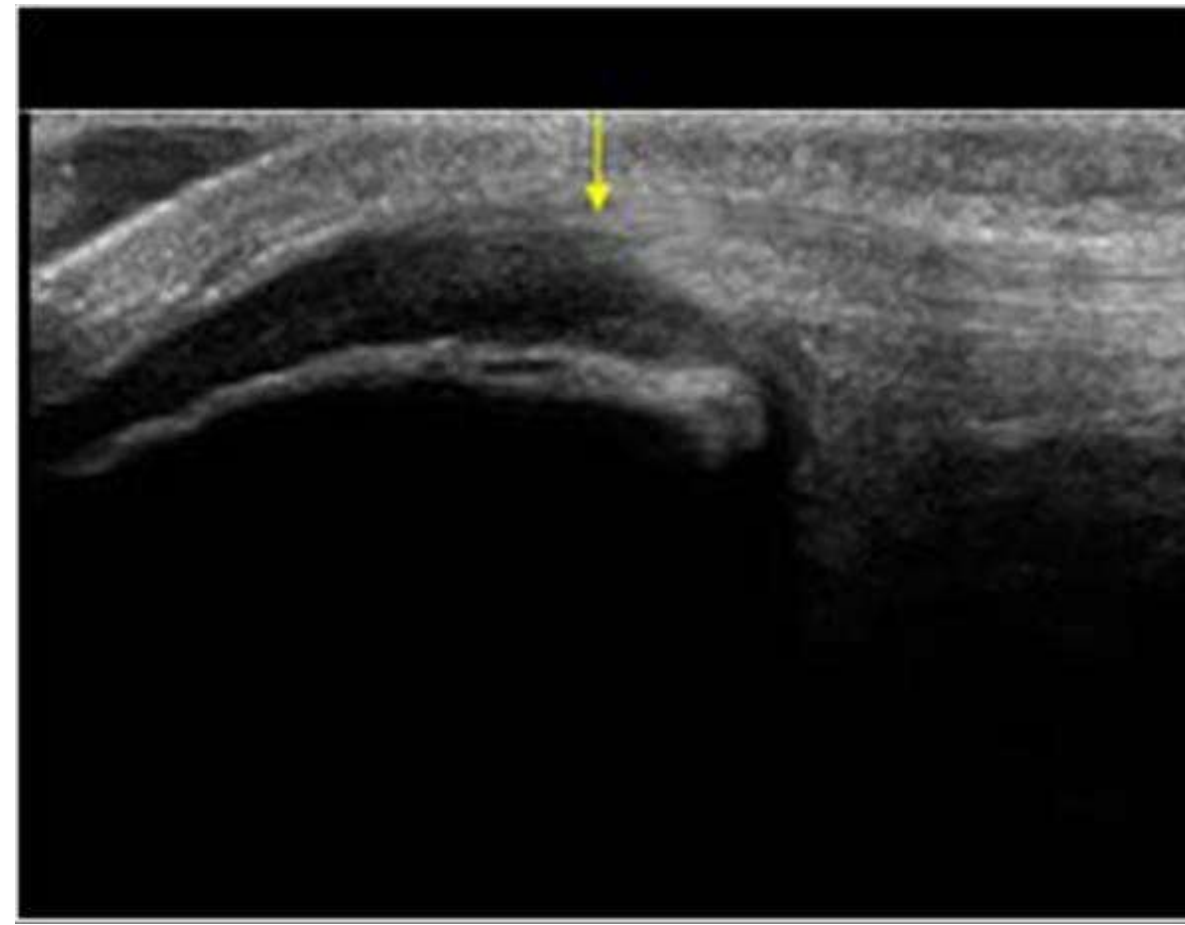
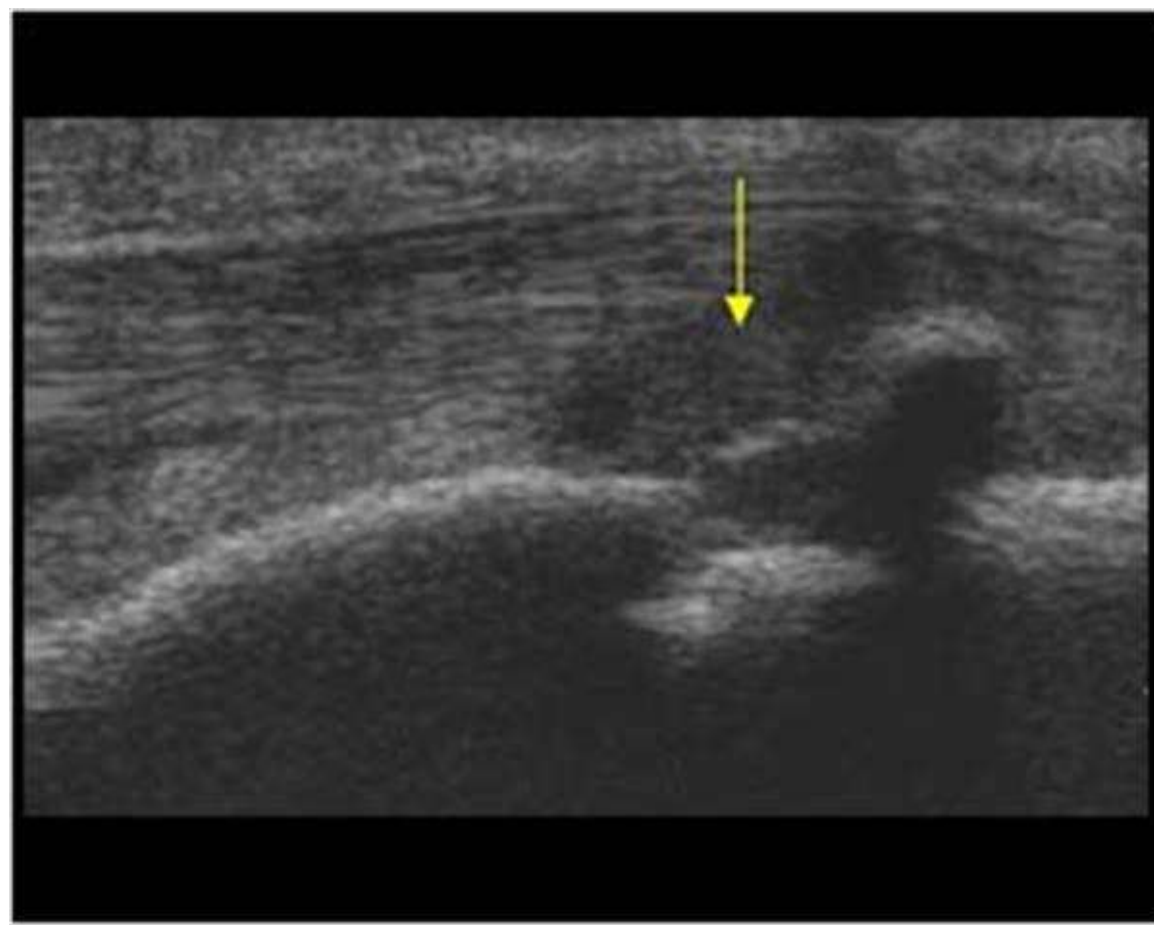
X-ray depicting growth plate at the lower pole of the patella. Case courtesy of Dr Aneta Kecler-Pietrzyk, Radiopaedia.org, rID: 55672



SIZES CALIBRATED - APPROX (1:1.01)







De Flaviis et al.  
1989

Holden et al. 2021

# Brief Summary

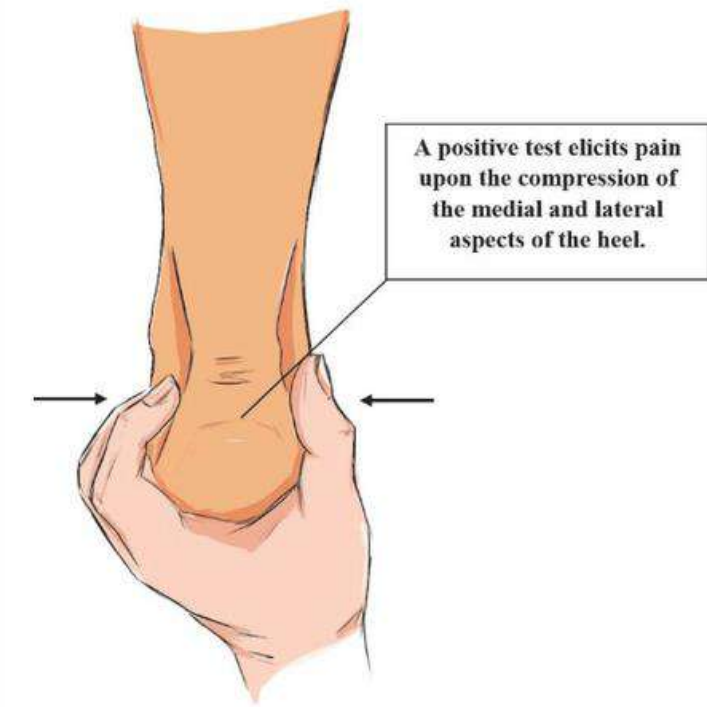
|                      | Osgood-Schlatter                                                          | Sinding-Larsen-Johansson                                                        | Sever's                                                                               |
|----------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Sport                | Yes (running, jumping-landing, side-cut)+early sport specialization       |                                                                                 |                                                                                       |
| Sex                  | mostly male                                                               |                                                                                 |                                                                                       |
| Age                  | 12-15 yrs*(8-15)                                                          | 10-13 yrs*(9-17)                                                                | 10-12 yrs*(7-15)                                                                      |
| PHV                  | circa                                                                     | before/circa                                                                    | before                                                                                |
| Symptoms (time)      | 3-18 months                                                               | 3-18 months                                                                     | 1-3months                                                                             |
| Bilaterally?         | Yes (around 50%)                                                          | Yes                                                                             | rarely (9%)                                                                           |
| Most common symptoms | Pain over the tibial tuberosity, increasing during activity and kneeling. | Pain at the inferior pole of the patella, especially during jumping or running. | Pain in the posterior aspect of the heel during activity or when wearing tight shoes. |
| Localization         | Insertion of the patellar tendon at the tibial tuberosity.                | Inferior pole of the patella, at the origin of the patellar tendon.             | Calcaneal tuberosity, at the insertion of the Achilles tendon.                        |

*Rodrigues et al. 2025*

*Wilczyński et al. 2024*

*Nieto-Gil et al. 2023*

*Rathleff et al. 2022*



*Fares et al. 2021*  
*Tommey 2009*



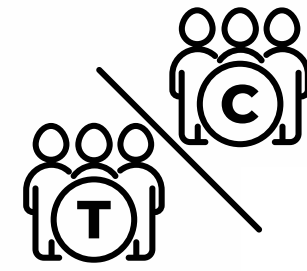
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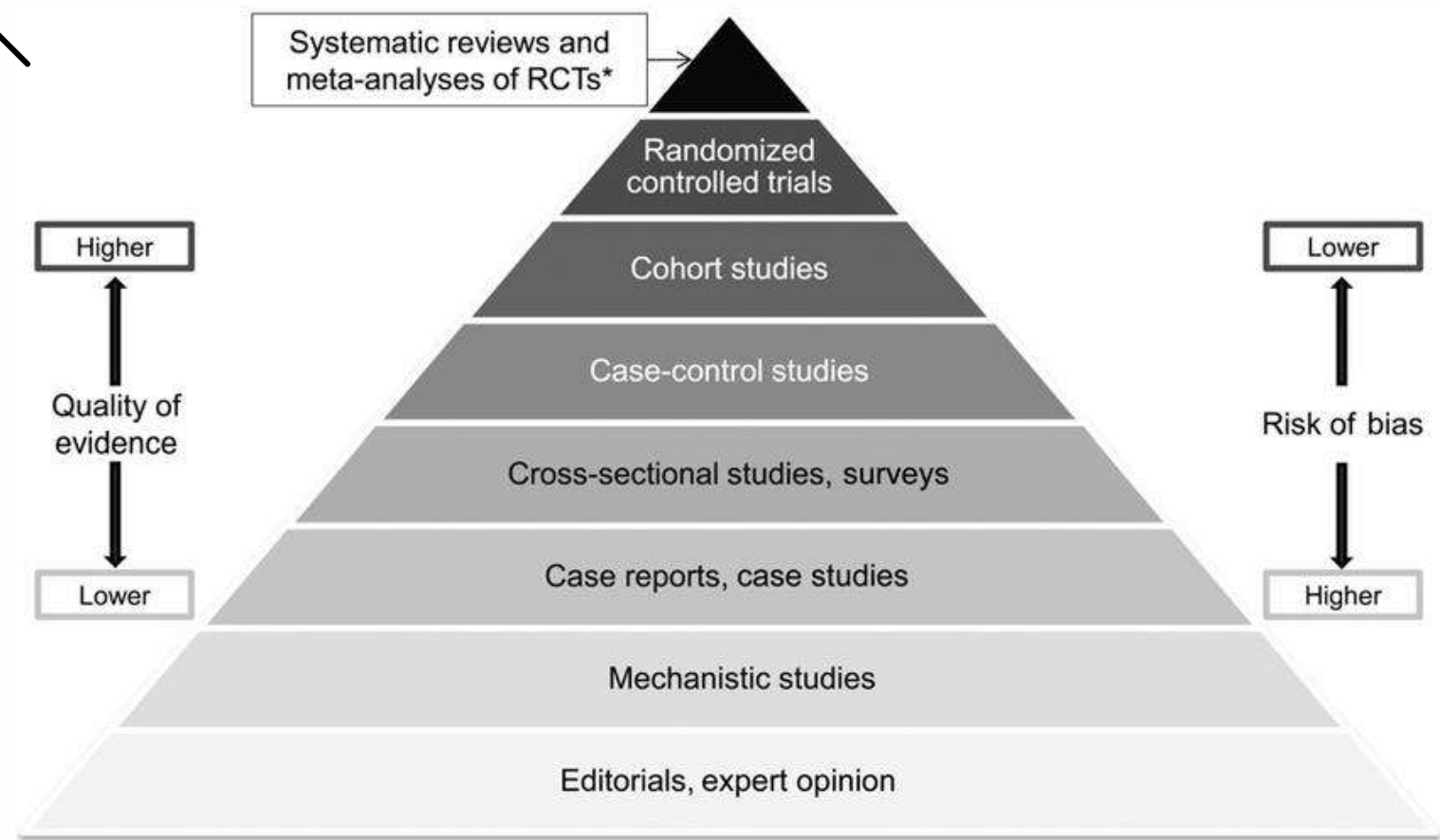
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# OSD/SLJ= LACK OF RCT!



- application of cold, knee orthoses (Yen 2014)
- physical therapy (Bezuglov et al 2020, Gerulis et al. 2004)
- stretching (quadriceps, hamstring, gastrocnemius) (Vreju et al. 2010, Bezuglov et al. 2020, Launay 2014, Ross et al. 2003)



**Quit knee pain  
- Osgood Schlatter**

AALBORG SYGEHUS  
ÅRHUS UNIVERSITETSHOSPITAL



## Sinding-Larsen-Johansson disease. Clinical features, imaging findings, conservative treatments and research perspectives: a scoping review

Bartosz Wilczyński<sup>1</sup>, Marcin Taraszkiewicz<sup>2</sup>, Karol de Tillier<sup>2</sup>, Maciej Biały<sup>3</sup> and Katarzyna Zorena<sup>1</sup>

<sup>1</sup> Department of Immunobiology and Environmental Microbiology, Medical University of Gdansk, Gdansk, Poland  
<sup>2</sup> Medical University of Gdansk, Gdansk, Poland  
<sup>3</sup> Institute of Physiotherapy and Health Sciences, The Jerzy Kukuczka Academy of Physical Education, Katowice, Poland



rest and/or cryotherapy, passive mobilization, muscle stretching, isometric exercises, and NSAIDs  
Low to moderate risk of bias  
(JBI Critical Appraisal for Case Reports)

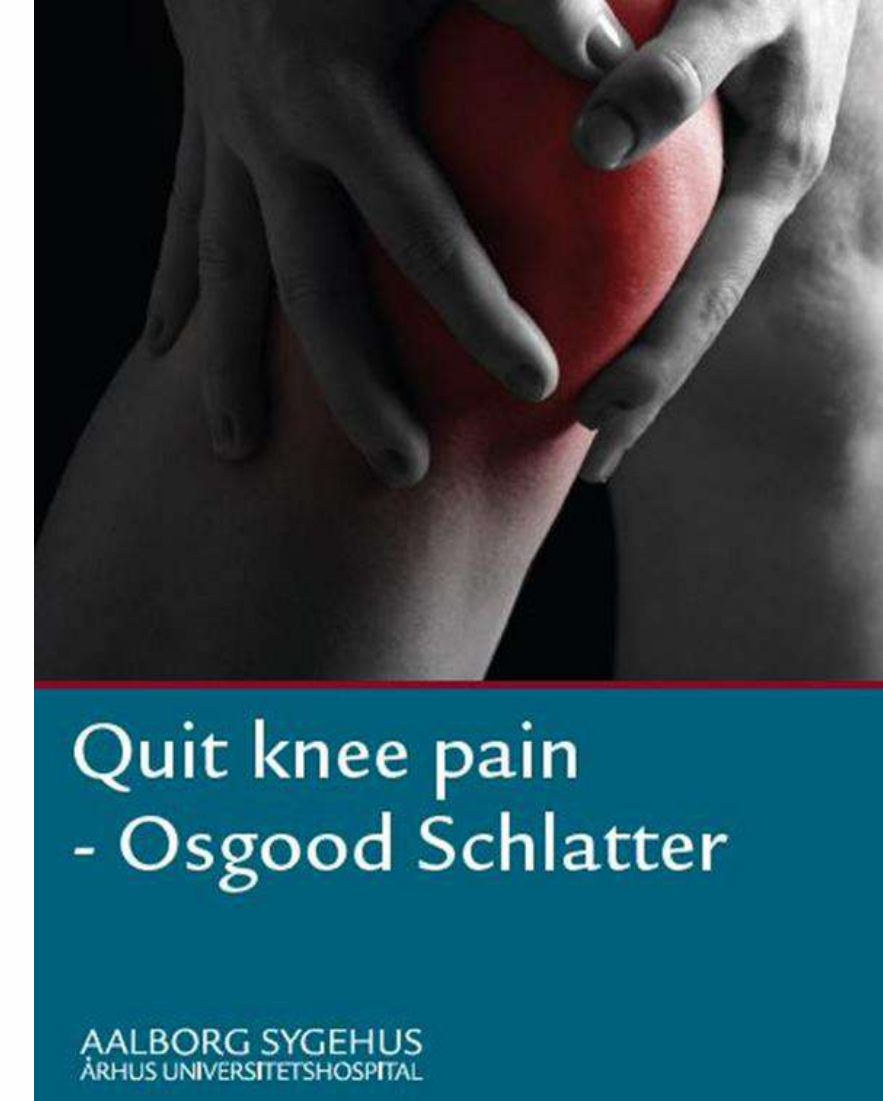
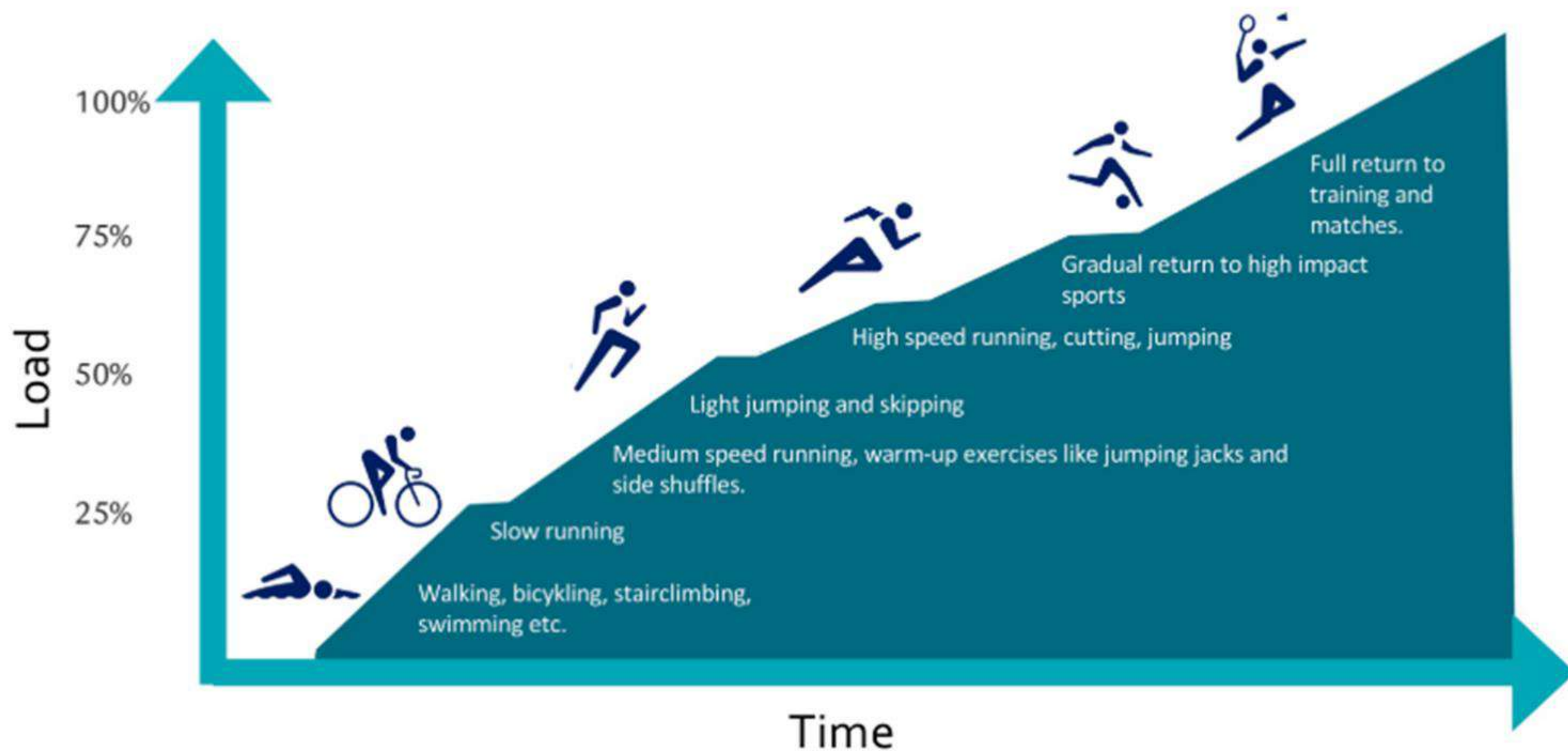
## Activity Modification and Knee Strengthening for Osgood-Schlatter Disease

### A Prospective Cohort Study

Michael S. Rathleff,<sup>\*,†‡§</sup> PhD, Lukasz Winiarski,<sup>§</sup> MSc, Kasper Krommes,<sup>‡||</sup> MSc, Thomas Graven-Nielsen,<sup>¶</sup> PhD, Per Hölmich,<sup>||</sup> DrMed, Jens Lykkegaard Olesen,<sup>‡#</sup> PhD, Sinéad Holden,<sup>†‡</sup> PhD, and Kristian Thorborg,<sup>||</sup> PhD  
Investigation performed at Aalborg University Hospital, Aalborg, Denmark, and the Department of Orthopaedic Surgery, Copenhagen University Hospital, Amager-Hvidovre, Denmark

**6<sup>th</sup>**  
**POLISH ARTHROSCOPY SOCIETY CONGRESS**  
15-17 October 2025  
ICE Kraków Congress Centre, Cracow, Poland

Polish Arthroscopy Society

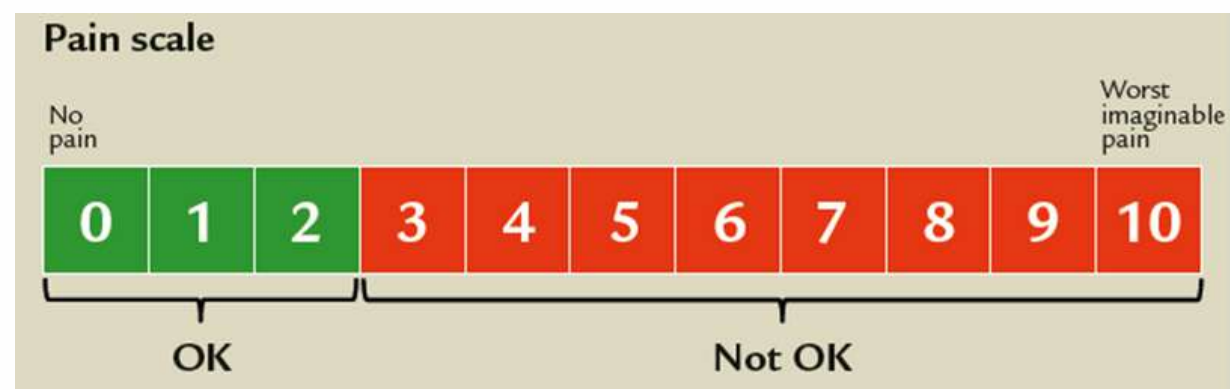


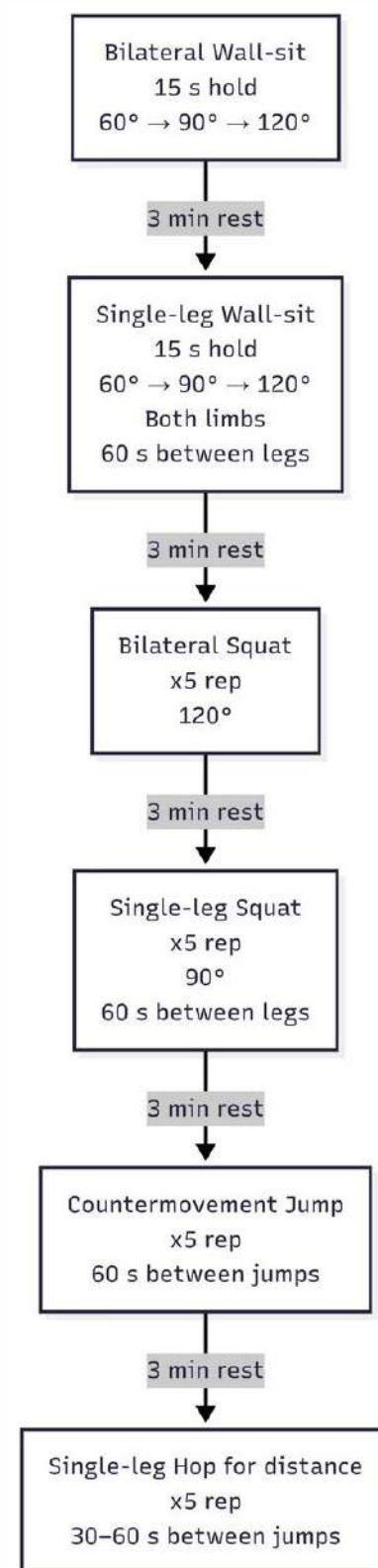
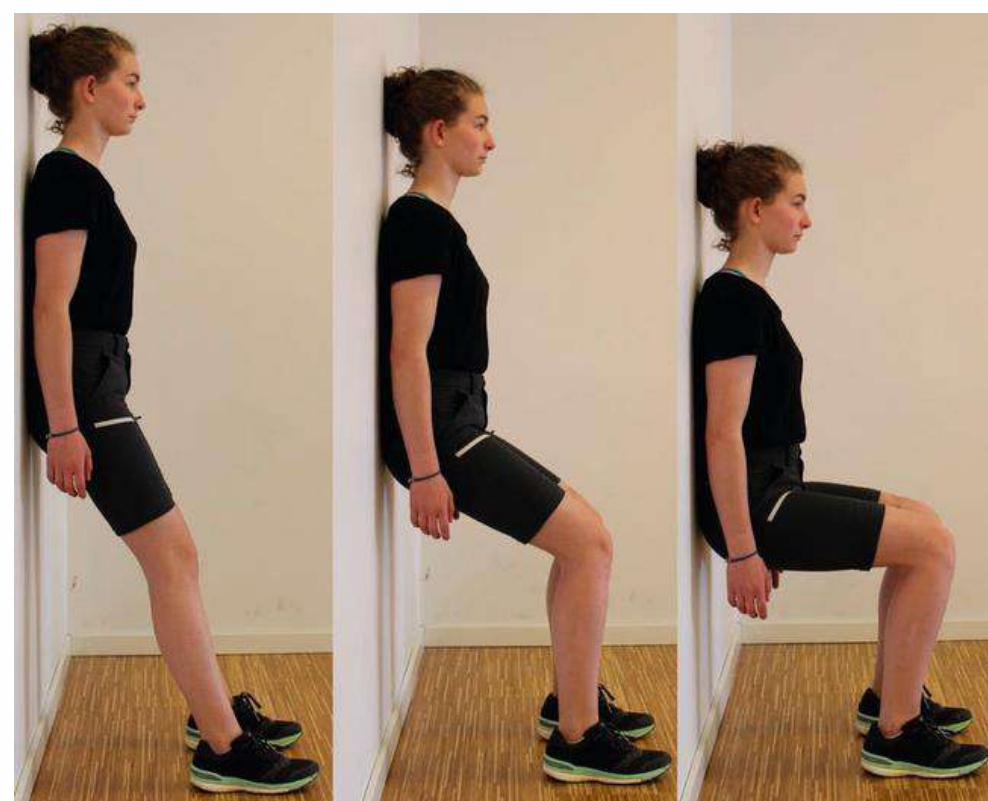
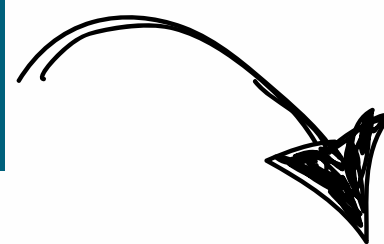
Original Research

## Activity Modification and Knee Strengthening for Osgood-Schlatter Disease

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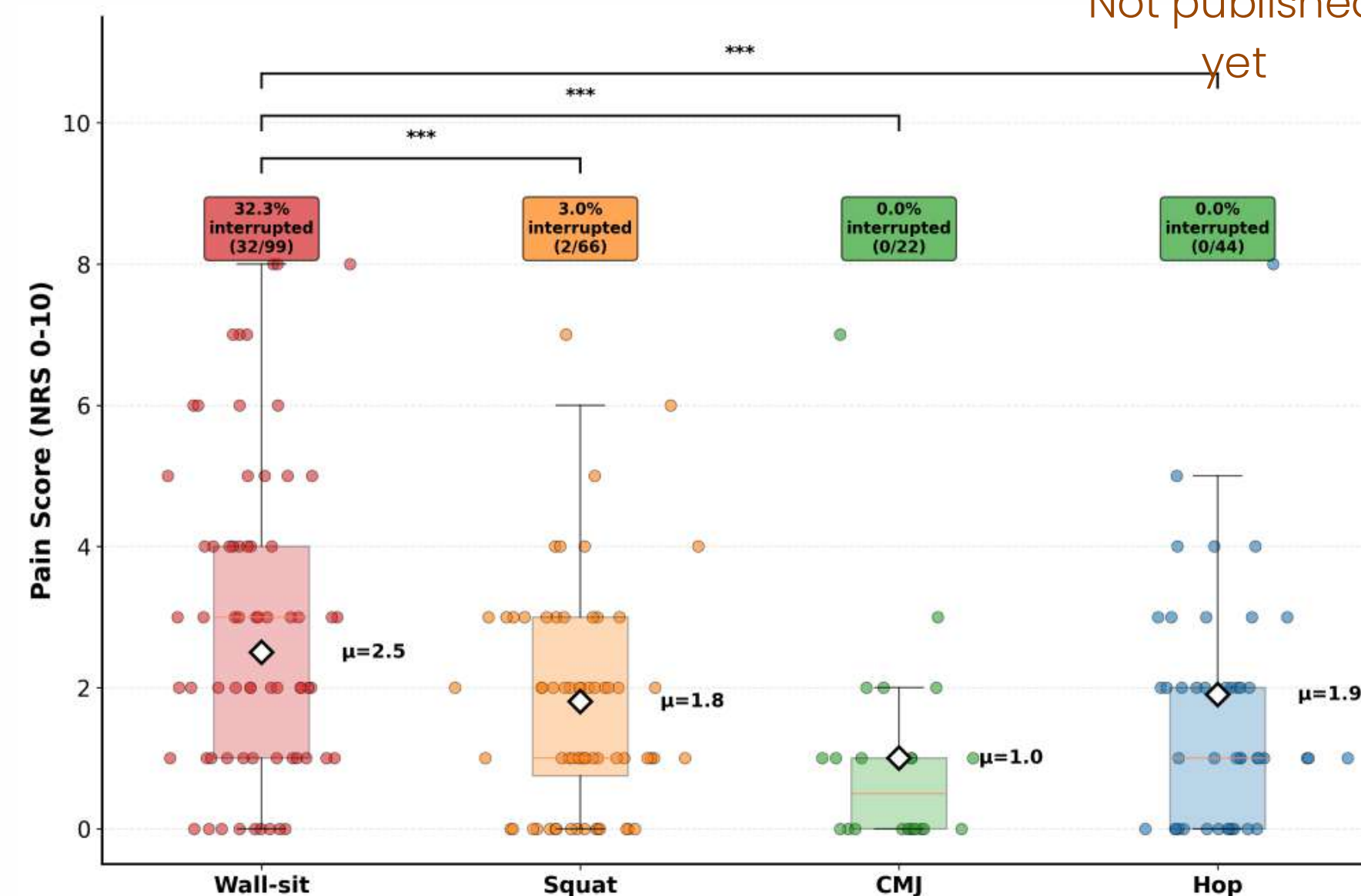
# Pain in Static and Dynamic Functional Testing in Adolescents with Osgood-Schlatter Lesions

Bartosz Wilczyński<sup>1</sup> and Dawid Machalewski<sup>2</sup>

<sup>1</sup>Department of Immunobiology and Environmental Microbiology, Medical University of Gdańsk, Gdańsk, Poland

<sup>2</sup>Gdańsk College of Health, Gdańsk, Poland

Not published yet



# Conservative Treatment of Sever’s Disease: A Systematic Review

Pablo Hernandez-Lucas <sup>1</sup>, Raquel Leirós-Rodríguez <sup>2,\*</sup>, Jesús García-Liñeira <sup>3</sup> and Helena Diez-Buil <sup>4</sup>

average PEDro score of 6.75 points.



| Score | Classification |
|-------|----------------|
| 0-4   | Poor           |
| 5-6   | Fair           |
| 7-10  | High           |

- ortopedic insoles
- Kinesio tape
- physical therapy (supervised, eccentric calf strenghtening, + home exercises)

## Treatment of Calcaneal Apophysitis: Wait and See Versus Orthotic Device Versus Physical Therapy: A Pragmatic Therapeutic Randomized Clinical Trial

Johannes I. Wiegerinck, MD, PhD,\*† Ruben Zwiers, MSc,† Inger N. Sierevelt, MSc,‡  
Henk C. P. M. van Weert, MD, PhD,§ C. Niek van Dijk, MD, PhD,†  
and Peter A. A. Struijs, MD, PhD†

Compared:  
activity cessation vs heel raise vs physiotherapy  
All ↓ heel pain significantly  
No difference between treatments



Fig. 2. The heel cup, the foot (in the study always supported by a sports shoe) and the heel wedge.

Perhamre et al.  
2011



Kuyucu et al. 2017



Figure 1. A, Cheetah heel cup (model Tuli's; Medi-Dyne Healthcare Products) and, B, The X Brace (model Tuli's; Medi-Dyne Healthcare Products).

Sweeney et al. 2023

# We still do not know...

PeerJ

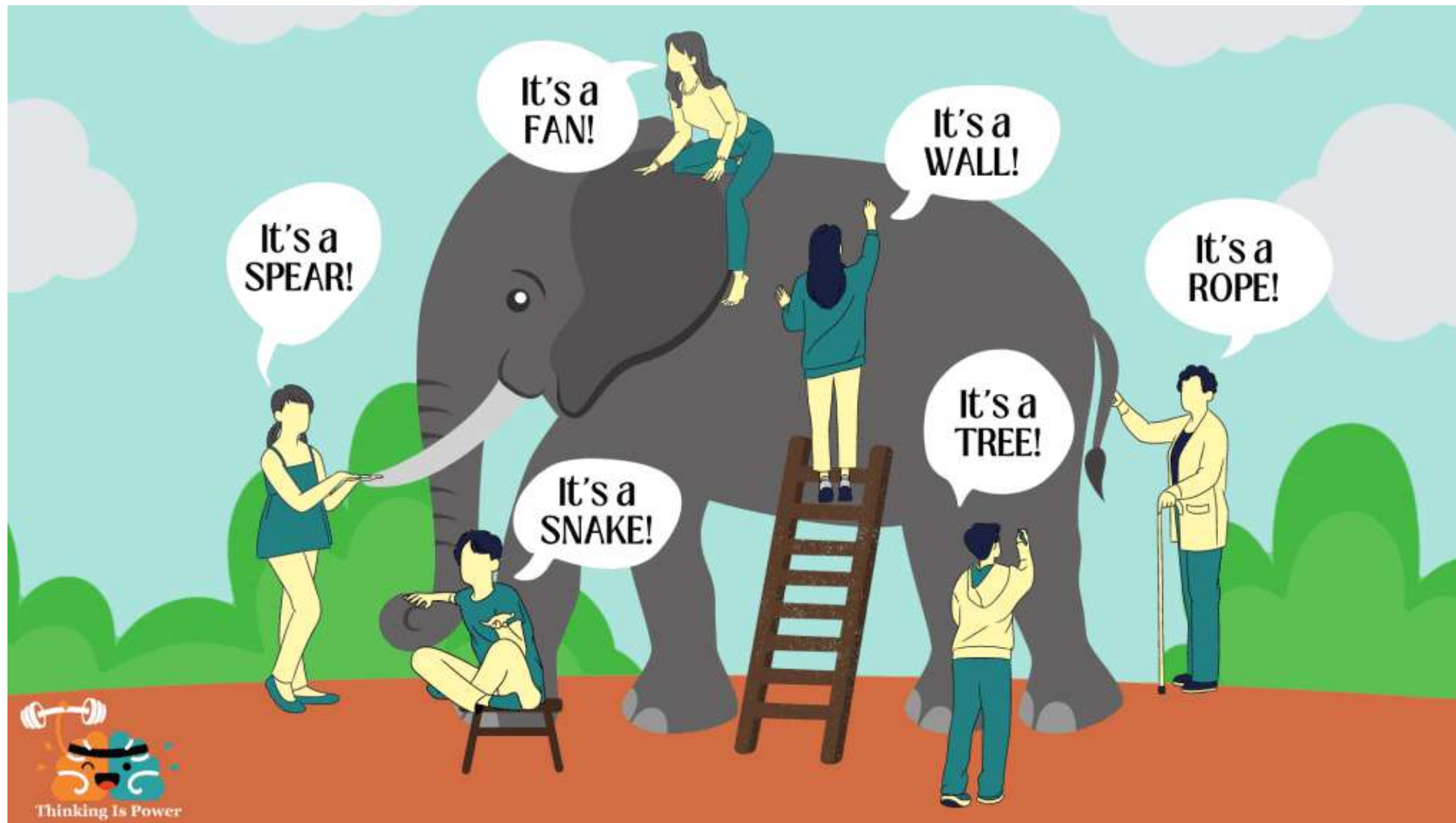
## Sinding-Larsen-Johansson disease. Clinical features, imaging findings, conservative treatments and research perspectives: a scoping review

Bartosz Wilczyński<sup>1</sup>, Marcin Taraszkiewicz<sup>2</sup>, Karol de Tillier<sup>2</sup>,  
Maciej Biały<sup>3</sup> and Katarzyna Zorena<sup>1</sup>

<sup>1</sup> Department of Immunobiology and Environmental Microbiology, Medical University of Gdansk, Gdansk, Poland

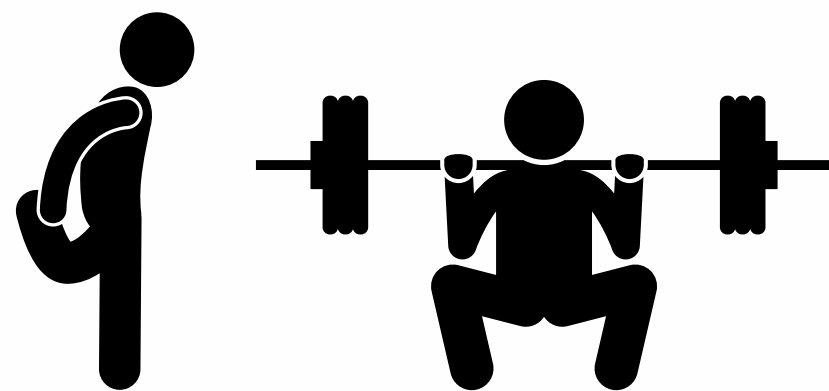
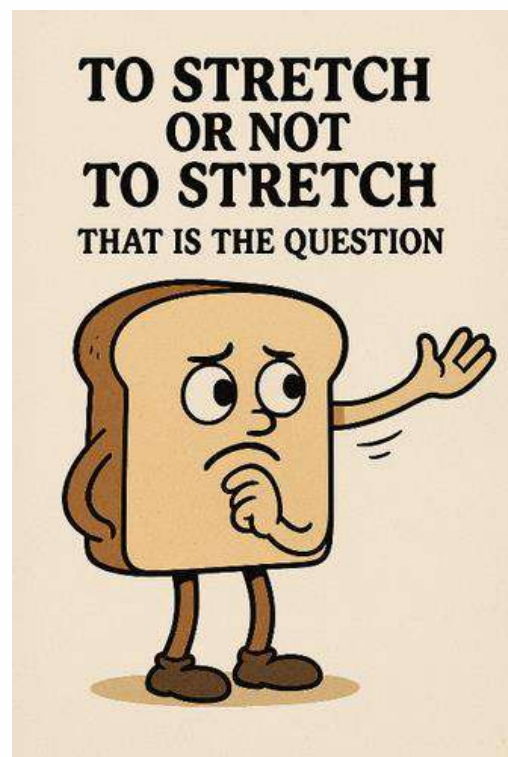
<sup>2</sup> Medical University of Gdansk, Gdansk, Poland

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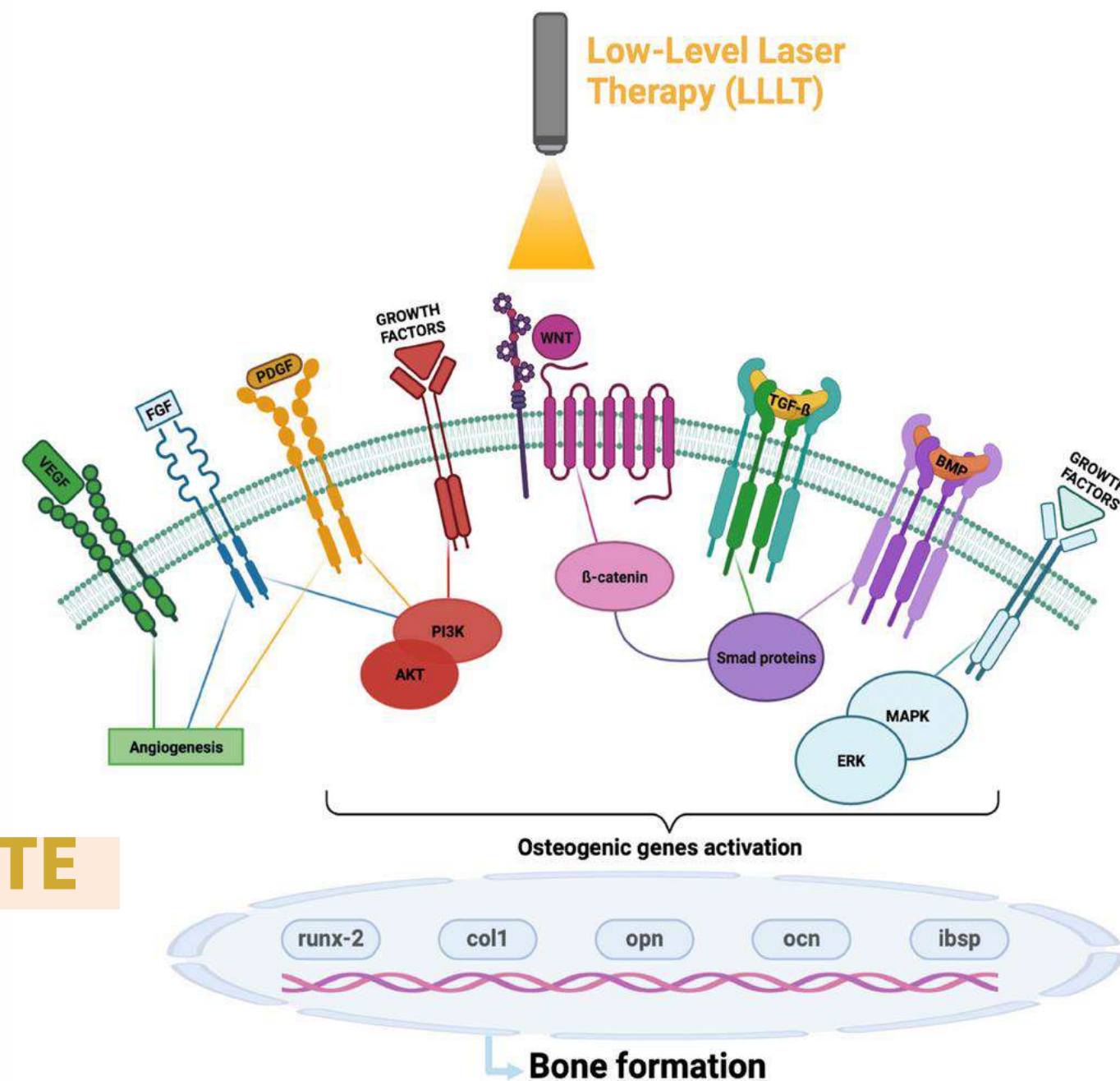


**Why do young athletes of the same age, height, BMI, gender, and training load experience apophysis changes while others do not?**



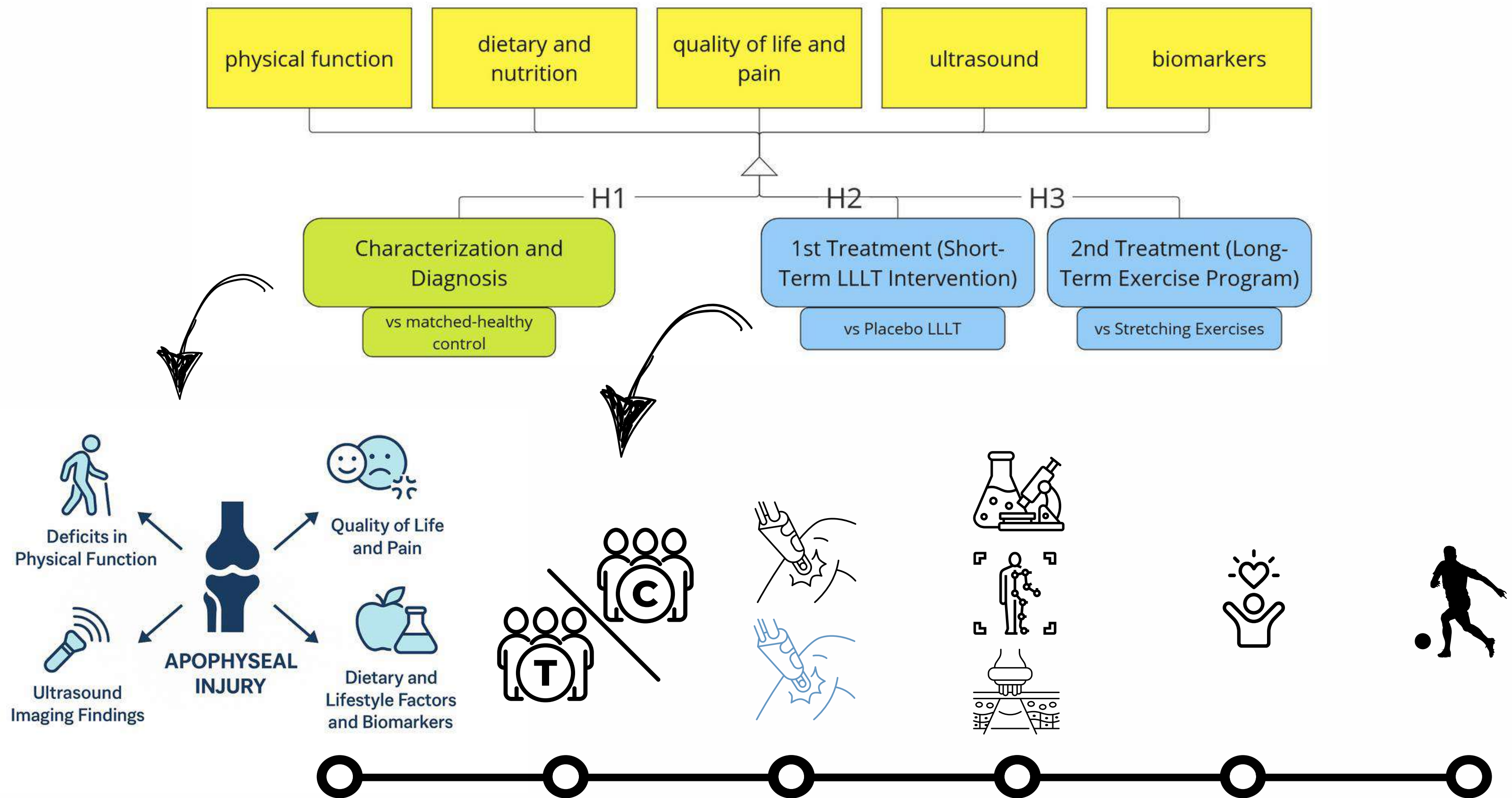


## CHRONIC VS ACUTE

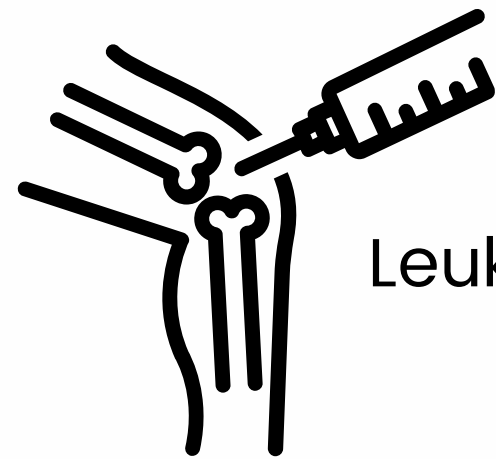


**Mechanisms:**  $\uparrow$  mitochondrial function & ATP,  $\downarrow$  oxidative stress & inflammation (Naterstad et al. 2022; Berni et al. 2023).





# How to treat? Conservative or...?



Leukocyte Rich-PRP

Acute vs. Chronic OSD

↑ VAS, Tegner, Lysholm, KOOS (both groups)

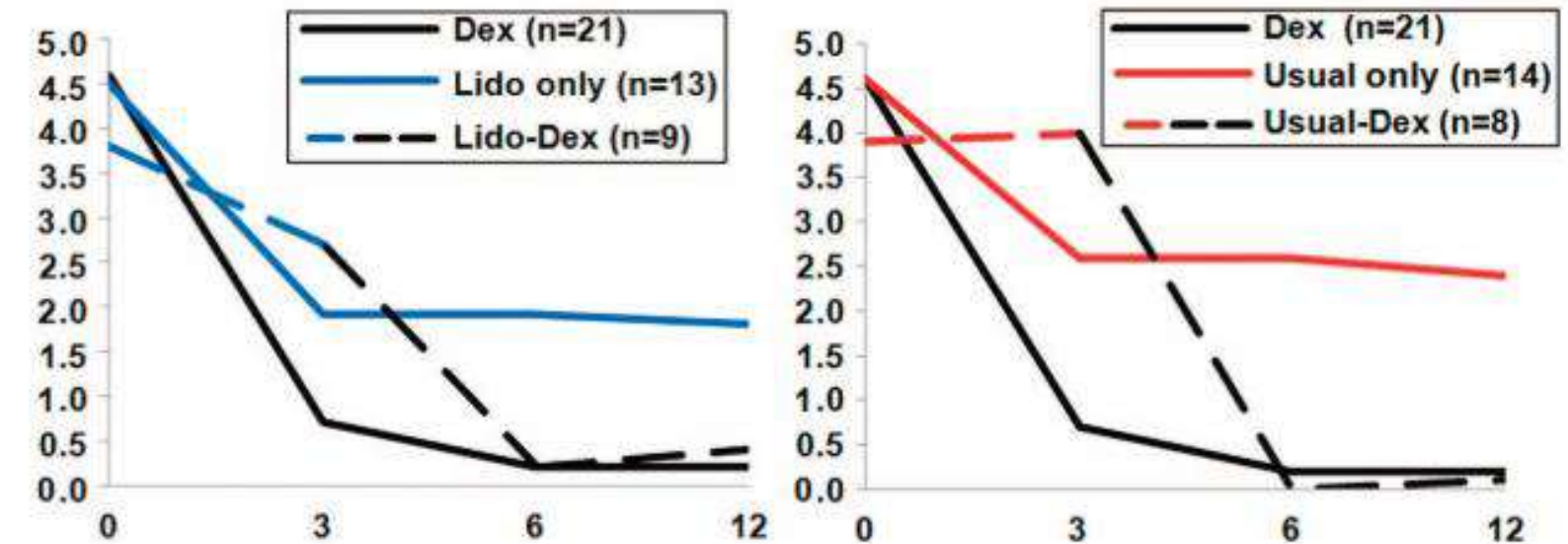
Better in acute OSD:

- Satisfaction 95% vs 64%
- MCID (VAS 100% | Tegner 95.5% | Lysholm 95% | KOOS 91%)

No adverse effects

safe, particularly beneficial in acute OSD

(Guszczyński et al., J Clin Med, 2024)



RCT: 12.5% Dextrose vs. Lidocaine vs. Usual Care (chronic OSD)

3 injections → 3 mo & 1 yr follow-up

3 mo:

- Unaltered sport: 100% vs 59% ( $p=.001$ )
- Asymptomatic sport: 67% vs 14% ( $p<.001$ )

1 yr: Asymptomatic knees → 84% (dextrose) vs 43% (lidocaine) vs 14% (usual care)

Safe, well tolerated

Effective for persistent OSD, faster return to sport

(Topol et al., Pediatrics, 2011)



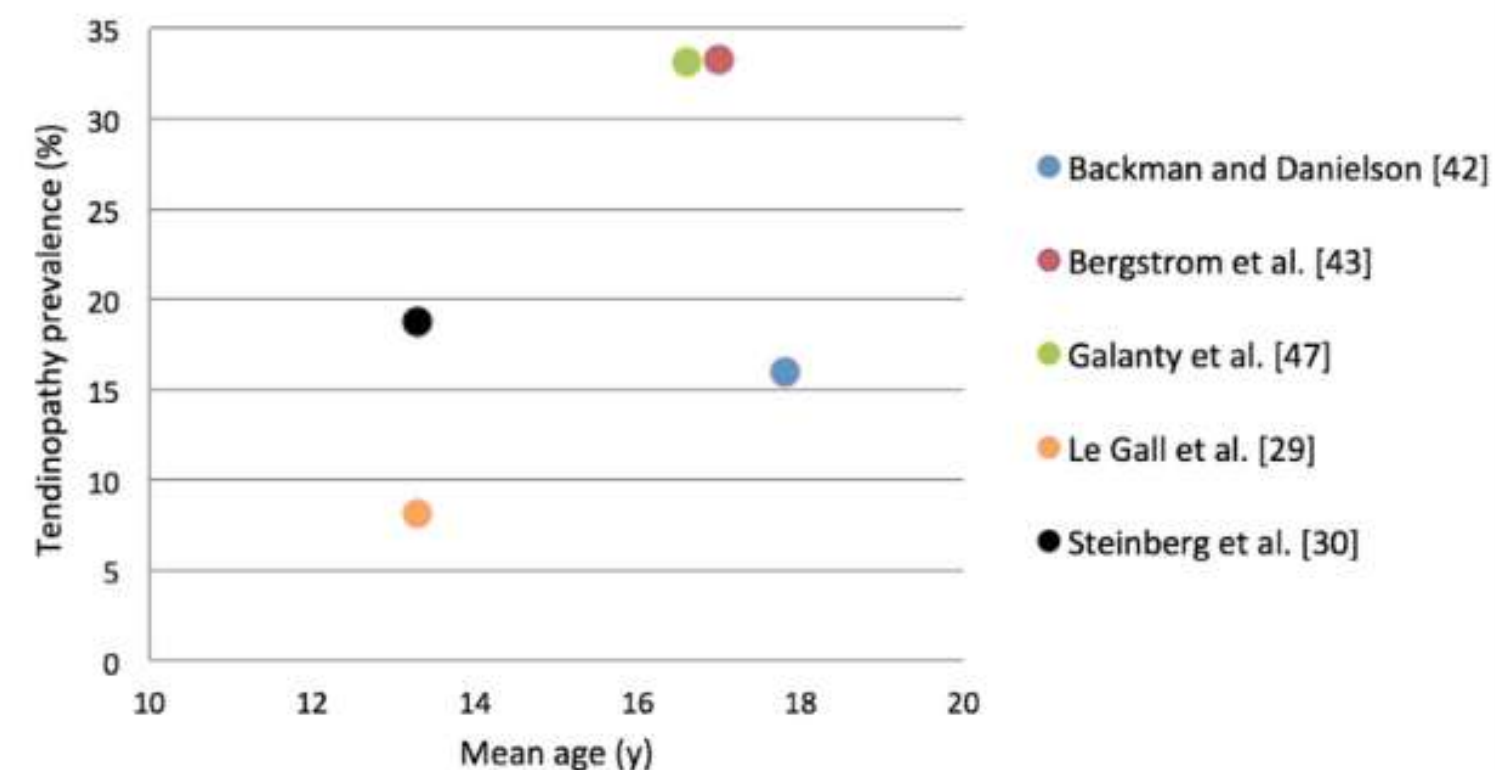
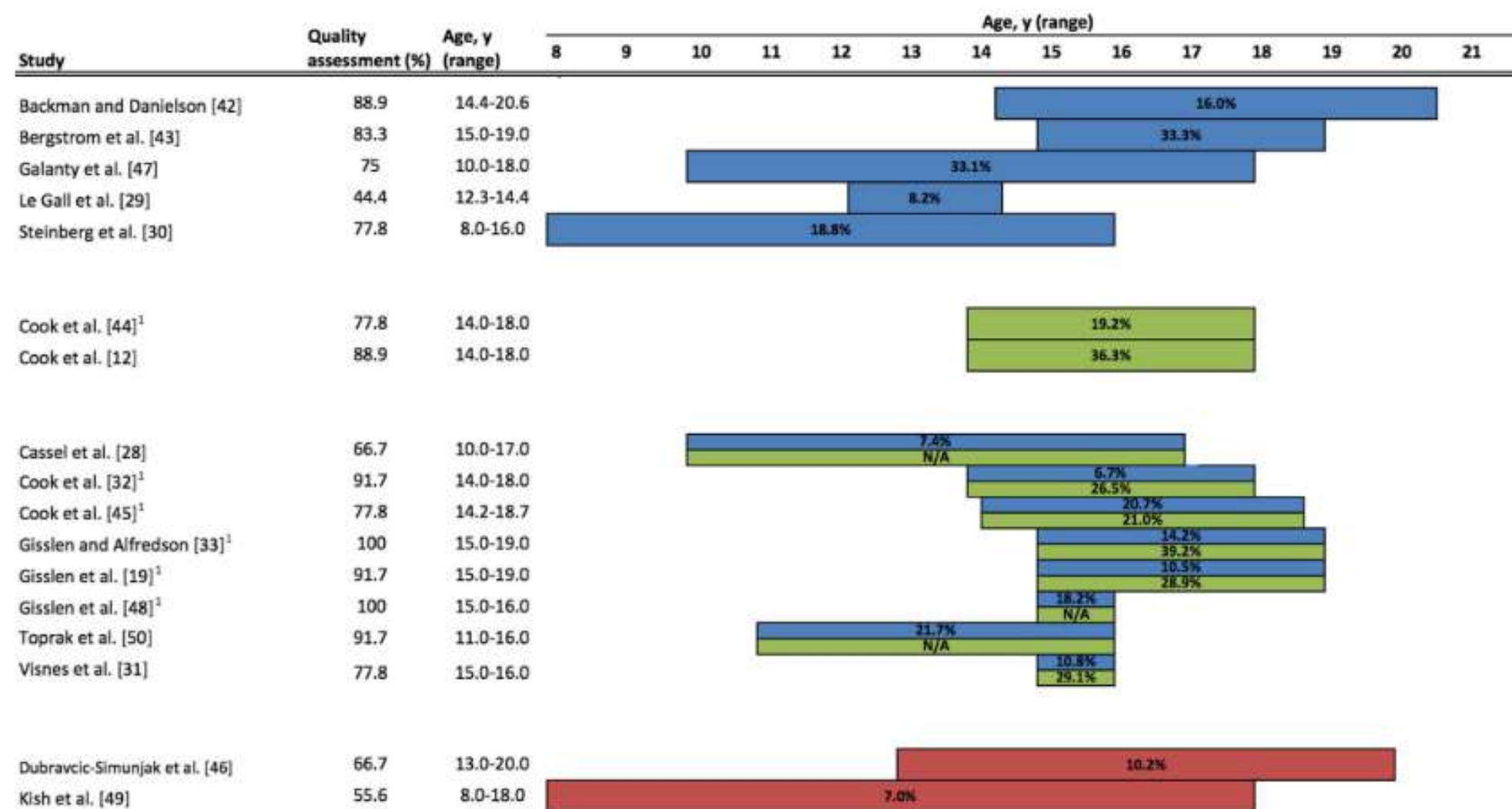
| Study       | Risk of bias domains |    |    |    |    | Overall |
|-------------|----------------------|----|----|----|----|---------|
|             | D1                   | D2 | D3 | D4 | D5 |         |
| Nakase 2020 | +                    | +  | +  | +  | -  | -       |
| Topol 2011  | +                    | +  | +  | -  | -  | -       |
| Wu 2022     | +                    | +  | -  | +  | -  | -       |

Domains:  
D1: Bias arising from the randomization process.

Judgement



## Is apophyseal injuries = youth tendinopathy?



The prevalence ranged from 8 to 33 %, while the age of the participants ranged between 14 and 20 years.

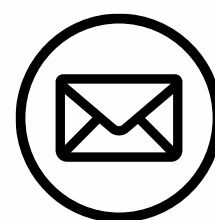
Simpson M, Rio E, Cook J (2016) At What Age Do Children and Adolescents Develop Lower Limb Tendon Pathology or Tendinopathy? A Systematic Review and Meta-analysis. *Sport Med* 46:545–557. <https://doi.org/10.1007/s40279-015-0438-0>



# THANK YOU!



**GitHub**



**bartosz.wilczynski@gumed.edu.pl**

