# Elite Male Soccer Players Have Greater Prominence of the Tibial Tuberosity, Greater Posterior Tibial Slope, and a Higher Incidence of Accessory Ossicles

Takuya Kinoshita, MD, PhD[1], Yusuke Hashimoto, MD, PhD[2], Kentaro Inui, MD, PhD[1], Masatoshi Hoshino, MD, PhD[1]

1. Department of Orthopaedic Surgery, Osaka Saiseikai Nakatsu hospital

2. Department of Health and Sport Management, Osaka University of Health and Sports Science, Graduate School of Sport and Exercise Science

# Disclosure

The authors of this presentation have the following to disclose concerning possible financial or personal relationships with commercial entities that may have a direct or indirect interest in the subject matter of this presentation:

- Takuya Kinoshita: No relationships to disclose
- Yusuke Hashimoto: No relationships to disclose
- Kentaro Inui: No relationships to disclose
- Masatoshi Hoshino: No relationships to disclose

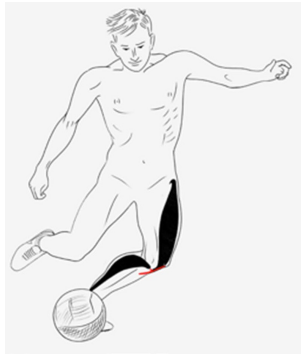
This study was conducted in accordance with ethical standards and appropriate institutional review board approval.

# Introduction

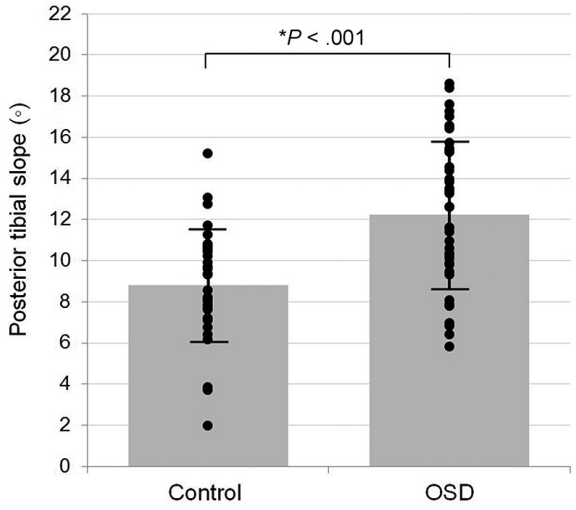
Soccer players experience considerable knee stress, particularly on the tibial tuberosity and patella, due to the kicking a ball, jumping and cutting since childhood.

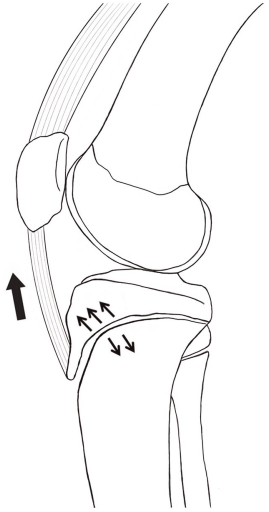
Repeated traction forces on the tibial tuberosity→Osgood-Schlatter disease (OSD)

Ladenhauf 2019 Curr Opin Pediatr, Pan 2022 AOTS



Gaulrapp 2021 Int Orthop



OSD and posterior tibial slope (PTS) are related

Does extension stress affect PTS?

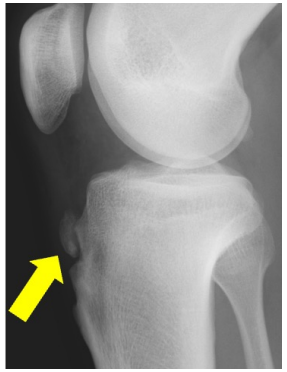
Green 2020 AJSM, Sheppard 2021 JPO

# Bone lesions affecting the knee extension mechanism

**ossicle associated with Osgood–Schlatter disease (OOSD)**

Secondary ossification center of tibial tuberosity remains as ossicles

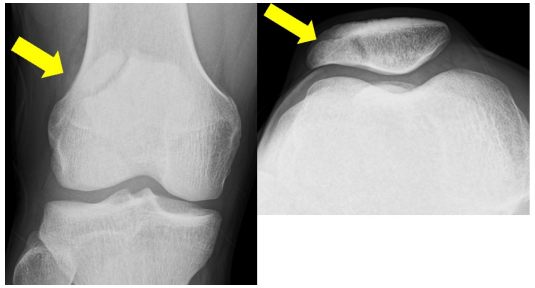
Fujita 2022 Arth Tech, Eun 2015 Arthroscopy, Pihlajamaki 2009 JBJS



**bipartite patella (BP)**

symptomatic rate 2%, common in athletes

Loewen 2021 OJSM, McMahon 2016 KSSTA, Matic 2015 Knee



It was **hypothesized** that male professional soccer players have greater prominence of the tibial tuberosity, greater PTS, and a higher OOSD and BP incidence.

This study **aimed** to identify the differences in knee bone morphology and accessory ossicles between soccer players and controls.

# Methods

## Soccer group

2013～2023　Professional male soccer players who had medical check-ups at our hospital

**334** knees　average 23.6 years　(16-35 years)

## Control group

2016～2023　Male patients age-matched to the soccer group (16-35 years) who visited our hospital and had undergone radiography **223** knees

average 24.7 years

exclusion
patellar dislocation (n = 5)
collagen disease with bone lesions (n = 2)
anterior cruciate ligament (ACL) reconstruction using a bone-patellar bone graft (n = 2)

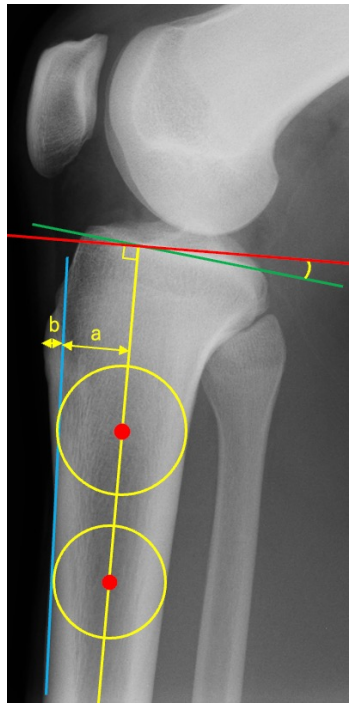
# Radiography Analyses

- ✓ tuberosity height ratio (**THR**) (b/a)
- ✓ **PTS**

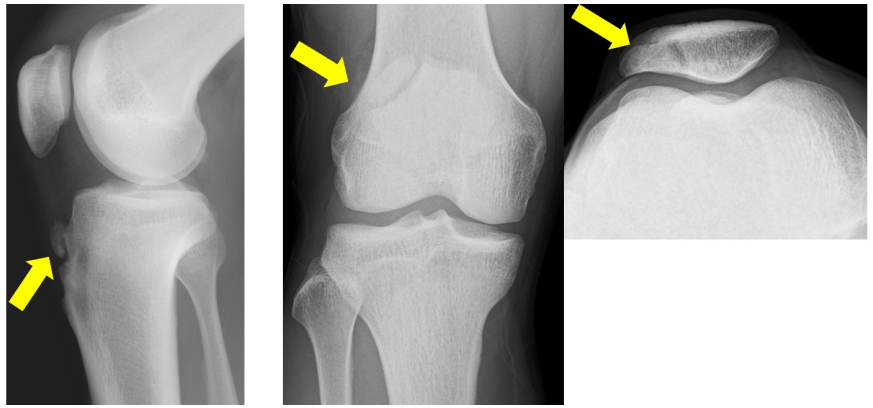
**THR**: Length (b) from anterior margin of tibia to tibial tuberosity tip, divided by length (a) from anterior margin to bone axis

**PTS**: Angle between perpendicular to bone axis and tangent to medial tibial plateau

Green 2020 AJSM




**OOSD** and **BP** incidence were evaluated using knee radiography



OOSD BP

# Results

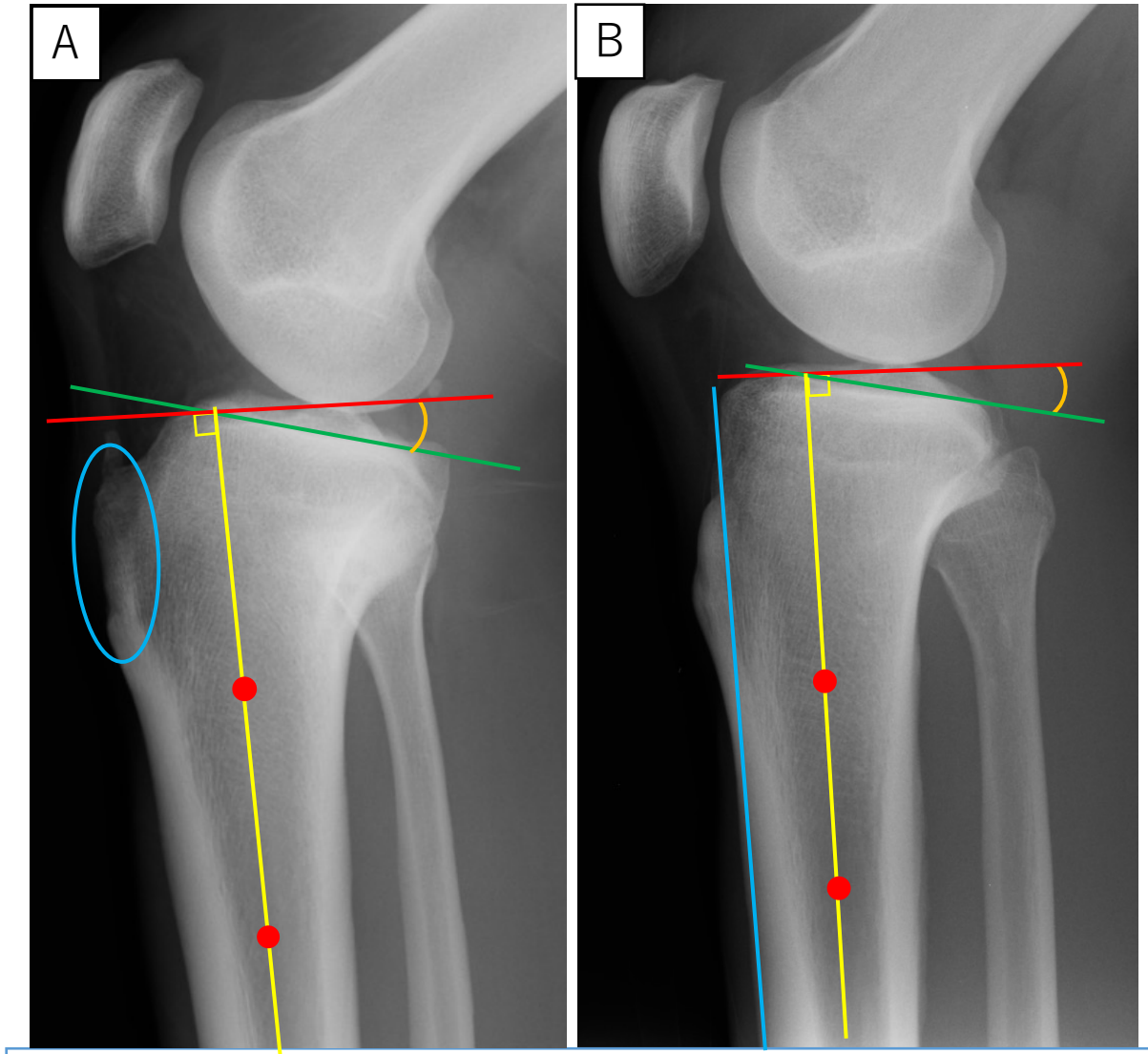
## Comparison of the Soccer group and the Control group

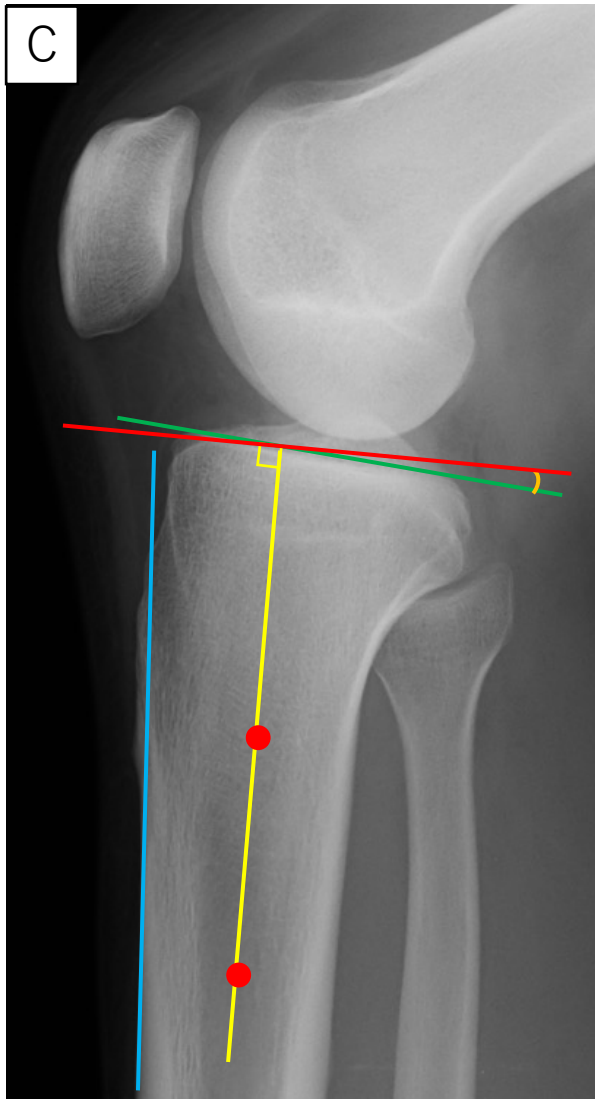
| | THR | PTS,° | OOSD,% | BP, % |
|---|---|---|---|---|
| Soccer | 0.276 | 9.42 | 10.8 | 6.3 |
| Control | 0.213 | 8.23 | 3.1 | 0.45 |
| P | <0.001 | <0.001 | 0.002 | 0.001 |

Representative images

Soccer

Control



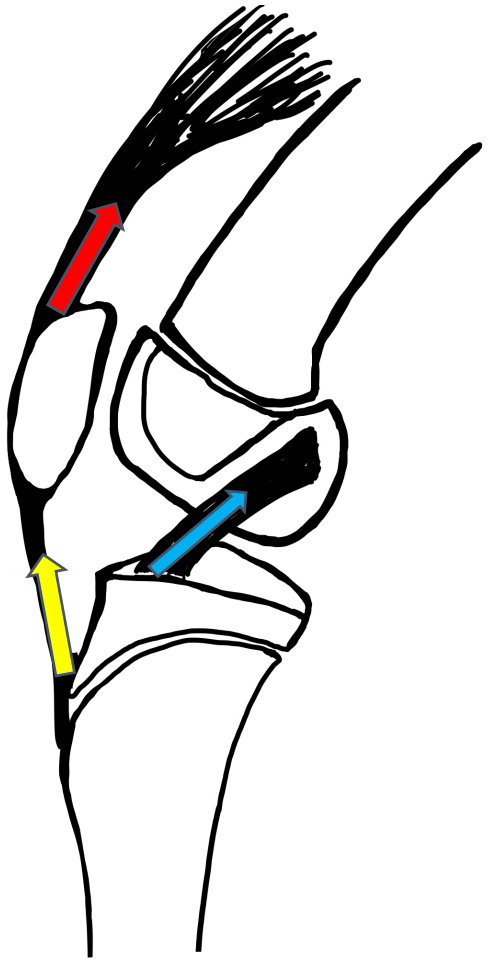




large prominence of the tibial tuberosity

substantial PTS

# Discussion

Male professional soccer players exhibited greater **prominence of the tibial tuberosity**, greater **PTS**, and a higher incidence of **OOSD** and **BP**

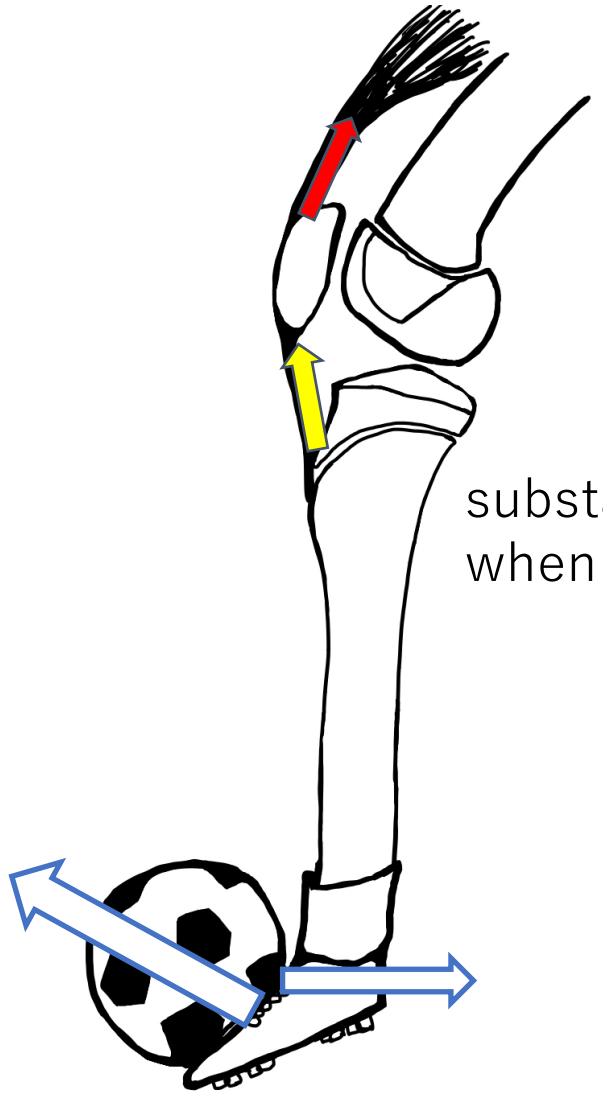


jumping, cutting, sprinting and kicking

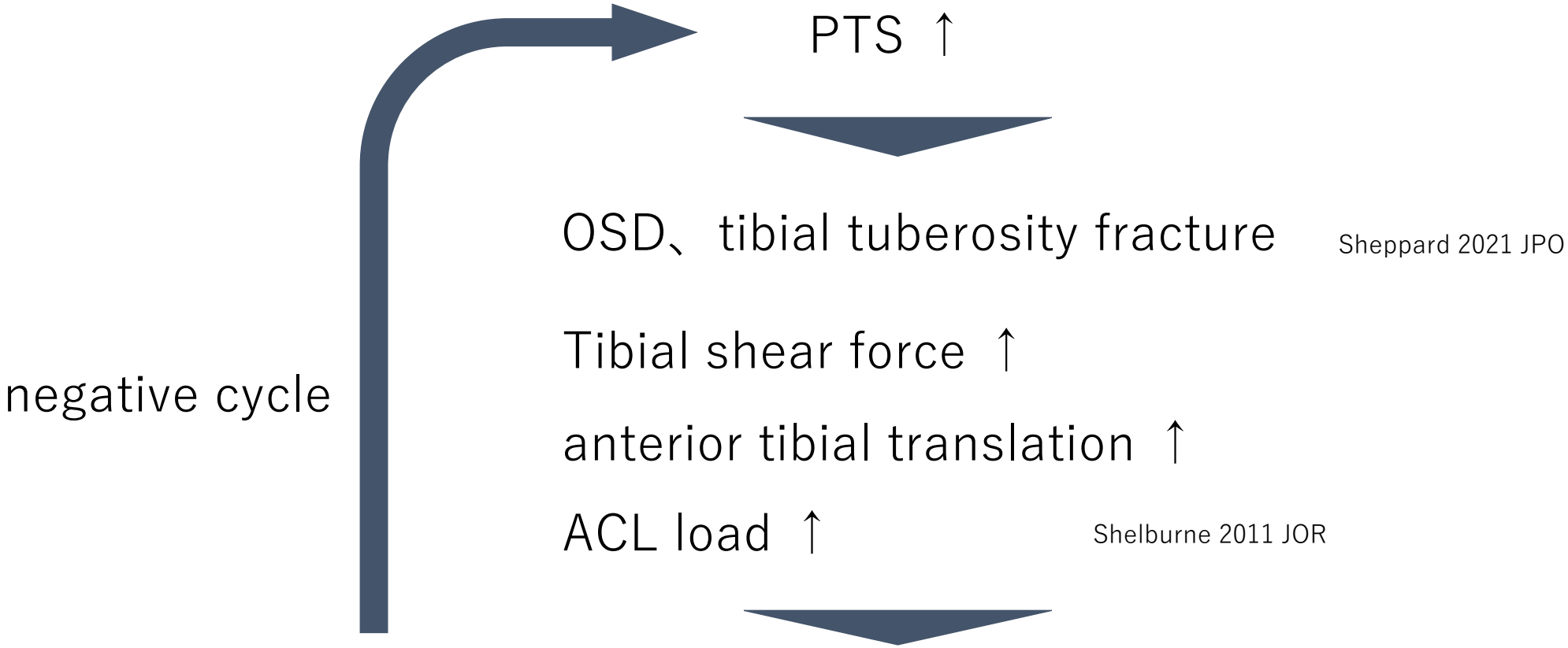
Traction of the quadriceps muscle on the superior patella

traction on the tibial tuberosity through the patellar tendon

traction on the anterior tibial plateau via the ACL



substantial load when kicking a ball




This may lead to an increase prominence of tibial tuberosity and PTS.

greater PTS → ACL injury risk Salmon 2018 AJSM , Webb 2013 AJSM

ACL injuries are most common in soccer players with a high risk of injury

Gornitzky 2016 AJSM

Male soccer players, subjected to heavy foot and ankle loading from childhood have a higher incidence of accessory ossicles in the foot and ankle. Kinoshita 2024 Int Orhop

| | OOSD, % | BP, % |
|---|---|---|
| Soccer | 10.8 | 6.3 |
| Control | 3.1 | 0.45 |
| P | 0.002 | 0.001 |

heavy tibial tuberosity and patella loading from childhood

↓

**OOSD**, **BP** incidence ↑

**OOSD** can cause symptoms and should be prevented Hirano 2002 Skeletal Radiol

**BP**
symptomatic rate 2%, common in athletes Loewen 2021 OJSM, McMahon 2016 KSSTA, Matic 2015 Knee

## Limitation

- Only male participants were included
- some participants in the control group might have played soccer or similar sports since childhood, and their activity level was unclear.
- Selection bias may have been present in the control group.

# Conclusion

- Elite male soccer players had greater prominence of the tibial tuberosity, greater PTS, and a higher incidence of OOSD and BP.

# References


1. Gaulrapp H, Nührenbörger C. The Osgood-Schlatter disease: a large clinical series with evaluation of risk factors, natural course, and outcomes. Int Orthop. 2022;46(2):197-204.
2. Ladenhauf HN, Seitlinger G, Green DW. Osgood-Schlatter disease: a 2020 update of a common knee condition in children. Curr Opin Pediatr. 2020;32(1):107-112.
3. Pan T, Mun F, Martinazzi B, King TS, Petfield JL, Hennrikus WL. The posterior tibial slope and Insall-Salvati index in operative and nonoperative adolescent athletes with Osgood-Schlatter disease. Arch Orthop Trauma Surg. 2022;142(12):3903-3907.
4. Green DW, Sidharthan S, Schlichte LM, Aitchison AH, Mintz DN. Increased Posterior Tibial Slope in Patients With Osgood-Schlatter Disease: A New Association. Am J Sports Med. 2020;48(3):642-646.
5. Sheppard ED, Ramamurti P, Stake S, Stadecker M, Rana MS, Oetgen ME, Young ML, Martin BD. Posterior Tibial Slope is Increased in Patients With Tibial Tubercle Fractures and Osgood-Schlatter Disease. J Pediatr Orthop. 20212;41(6):e411-e416.
6. Fujita K, Nakase J, Yoshimizu R, Kimura M, Kanayama T, Tsuchiya H. Bursoscopic Ultrasound-Guided Ossicle Resection for Osgood-Schlatter Disease. Arthrosc Tech. 2022;11(5):e841-e846.
7. Eun SS, Lee SA, Kumar R, Sul EJ, Lee SH, Ahn JH, Chang MJ. Direct bursoscopic ossicle resection in young and active patients with unresolved Osgood-Schlatter disease. Arthroscopy. 2015;31(3):416-21.
8. Pihlajamäki HK, Mattila VM, Parviainen M, Kiuru MJ, Visuri TI. Long-term outcome after surgical treatment of unresolved Osgood-Schlatter disease in young men. J Bone Joint Surg Am. 2009;91(10):2350-8.
9. Loewen A, Ge SM, Marwan Y, Burman M, Martineau PA. Arthroscopic Management for Bipartite Patella: A Systematic Review. Orthop J Sports Med. 2021;9(8):23259671211022248.
10. McMahon SE, LeRoux JA, Smith TO, Hing CB. The management of the painful bipartite patella: a systematic review. Knee Surg Sports Traumatol Arthrosc. 2016;24(9):2798-2805.
11. Shelburne KB, Kim HJ, Sterett WI, Pandy MG. Effect of posterior tibial slope on knee biomechanics during functional activity. J Orthop Res. 2011;29(2):223-31.
12. Salmon LJ, Heath E, Akrawi H, Roe JP, Linklater J, Pinczewski LA. 20-Year Outcomes of Anterior Cruciate Ligament Reconstruction With Hamstring Tendon Autograft: The Catastrophic Effect of Age and Posterior Tibial Slope. Am J Sports Med. 2018;46(3):531-543.
13. Webb JM, Salmon LJ, Leclerc E, Pinczewski LA, Roe JP. Posterior tibial slope and further anterior cruciate ligament injuries in the anterior cruciate ligament-reconstructed patient. Am J Sports Med. 2013;41(12):2800-4.
14. Gornitzky AL, Lott A, Yellin JL, Fabricant PD, Lawrence JT, Ganley TJ. Sport-Specific Yearly Risk and Incidence of Anterior Cruciate Ligament Tears in High School Athletes: A Systematic Review and Meta-analysis. Am J Sports Med. 2016;44(10):2716-2723.
15. Kinoshita T, Hashimoto Y, Inui K, Sugama R, Sugimoto T, Akizuki Y, Nakamura H. Male elite soccer players have a higher incidence of accessory ossicles in the foot and ankle. Int Orthop. 2024;48(4):1049-1055.
16. Hirano A, Fukubayashi T, Ishii T, Ochiai N. Magnetic resonance imaging of Osgood-Schlatter disease: the course of the disease. Skeletal Radiol. 2002;31(6):334-42.
17. Matic GT, Flanigan DC. Return to activity among athletes with a symptomatic bipartite patella: a systematic review. Knee. 2015;22(4):280-5.