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Three-Dimensional Change in Tibiofemoral Relationship After High Tibial Osteotomy: Medial Open Wedge Versus Lateral Closed Wedge

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Disclosure of Conflict of Interest

The authors have no financial conflicts to disclose.



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Introduction

Abbreviations

MOW: medial open wedge

LCW: lateral closed wedge

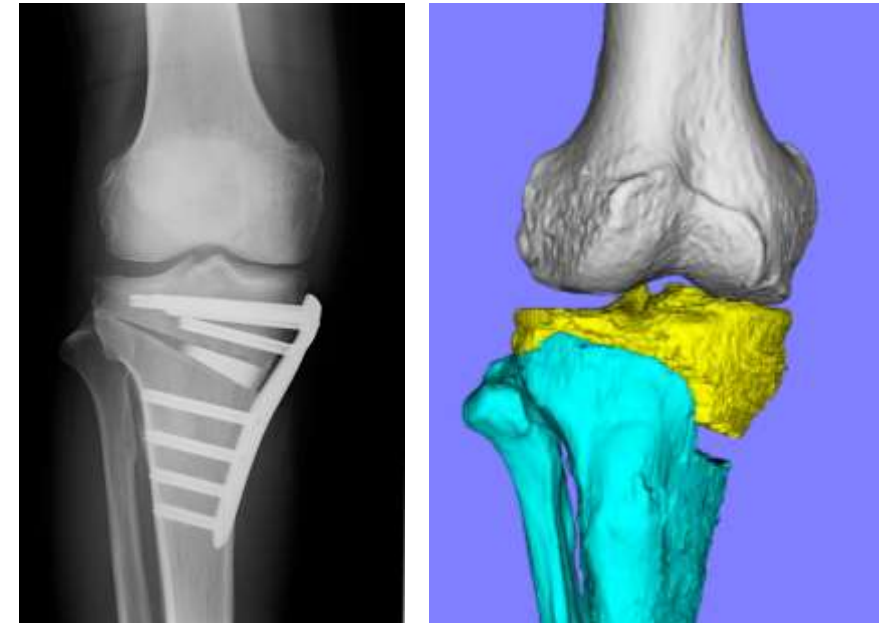
HTO: coronal correction for knee OA w/ varus malalignment

Unintended axial/sagittal alignment change

- ✓ Posterior tibial slope↑ (MOWHTO)
 - ✓ Distal tibial fragment
external rotation (MOWHTO)
 - ✓ Proximal tibial fragment
internal rotation (MOW & LCW HTO)
- Kim Il J, et al. AJSM 2020

El-Azab H , et al. AJSM 2010

3D tibiofemoral (T-F) relationship change ?
(positional & rotational change)

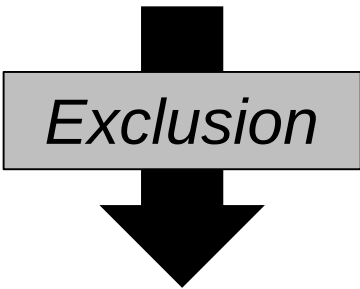


Purpose

To compare 3D change of T-F relationship after MOWHTO vs. LCWHTO

Methods

42 patients underwent HTO for medial knee OA (2019.4~2022.9)



Exclusion

- ACL/PCL insufficiency (n=5)
- unavailable whole-lower extremity CT images (n=11)
- concomitant meniscal/cartilage repair or LRR (n=4)
- distal tibial tuberosity osteotomy (n=5)

17 knees (MOW: 8 knees, LCW: 9 knees)

Surgery

MOWHTO

Locking plate w/ β -TCP spacer

Lobenhoffer P, et al. KSSTA 2003



Target %WBL: 62.5%

Fujisawa Y, et al. Orthop Clin North Am 1979

LCWHTO (hybrid)

Locking plate + supporting small plate

Takeuchi R, et al. Arthrosc Tech 2014



- ✓ Lesion in patellofemoral joint (pain, OA change)
- ✓ Flex. contracture $> 5^\circ$
- ✓ Correction angle $\geq 10^\circ$

Patient demographics

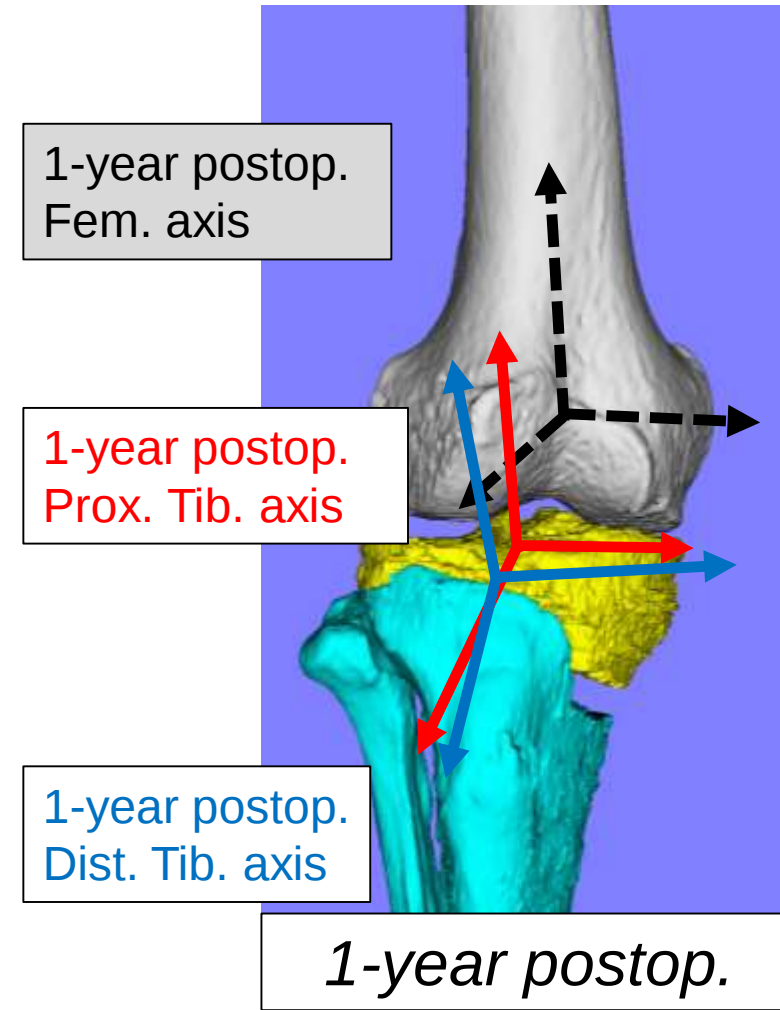
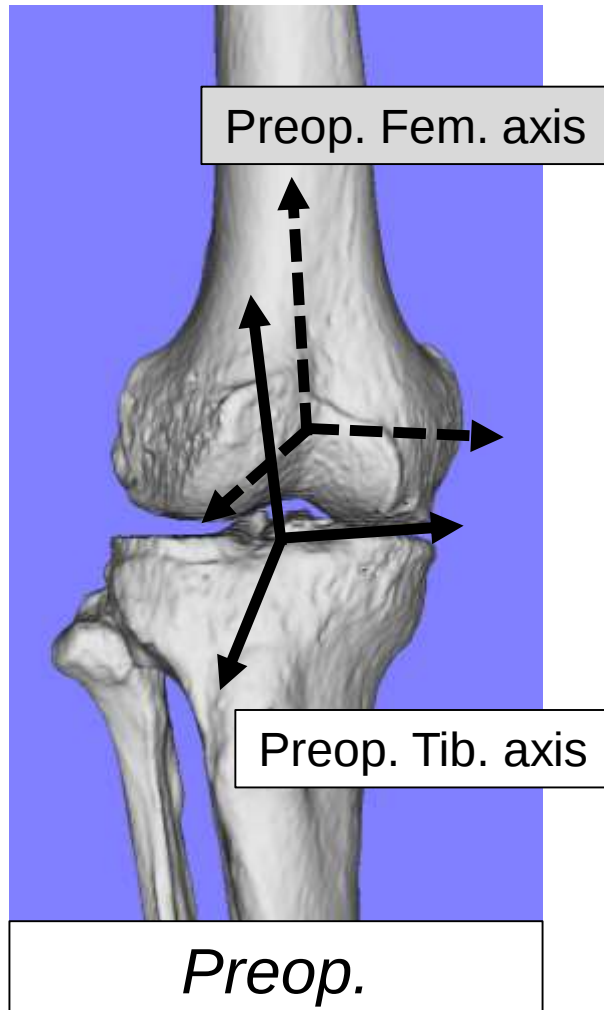
*: P<0.05 (Wilcoxon rank sum test)

	MOW (n=8)	LCW (n=9)	p-value
Sex(male/female)	3/5	8/1	0.05*
Age(y/o)	57±10 (44–69)	57±8 (45–76)	0.77
BMI	25±2 (20–33)	27±4 (55–97)	0.29
F/U period (mos.)	49±14 (27–67)	40±11 (26–59)	0.15
MPTA(°)	84±3 (81–87)	82±2 (79–86)	0.19
HKA (°)	185±3 (182–190)	189±3 (185–193)	<0.01*
FTA (°)	179±2 (177–182)	183±3 (179–187)	<0.01*
JLCA (°)	2±1 (1–5)	3±2 (0–6)	0.28
LDFA (°)	87±1 (85–89)	88±1 (86–90)	0.77
%WBL(%)	27±9 (9–37)	10±9 (-4–24)	<0.01*
PTS (°)	7±3 (3–11)	7±3 (3–10)	0.85
Correction angle(°)	8±2 (7–12)	13±1 (11–15)	<0.01*

BMI: body mass index, F/U: follow-up, MPTA: medial proximal tibial angle, HKA: hip-knee-ankle angle, FTA: femorotibial angle, JLCA: joint line convergence angle, LDFA: lateral distal femoral angle, WBL: weight bearing line, PTS: posterior tibial slope

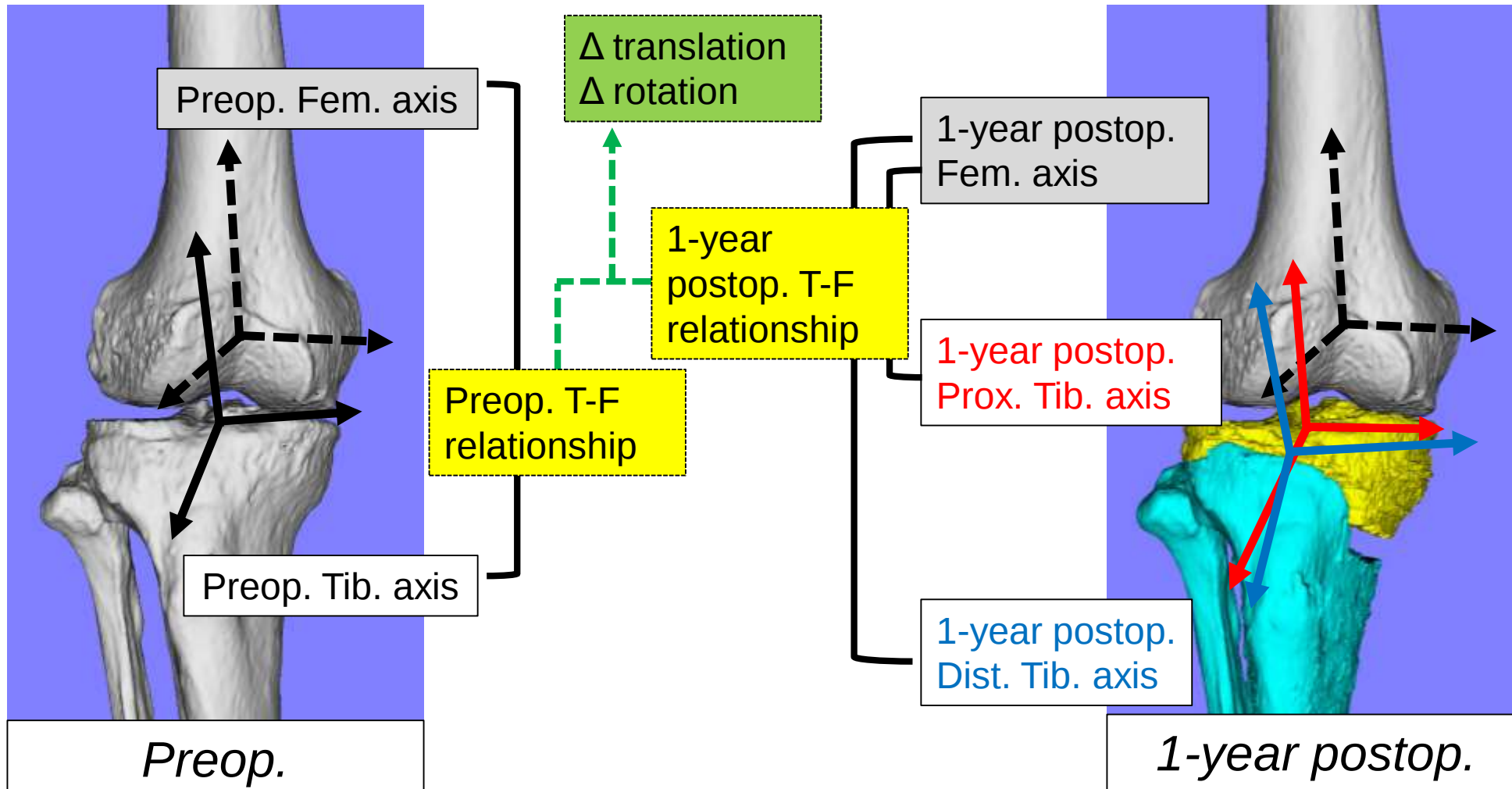
CT scan & 3D coordinate axes

- Preop. & 1-year postop., ranging whole lower extremity
- Supine, knee fully extended & relax muscular contraction



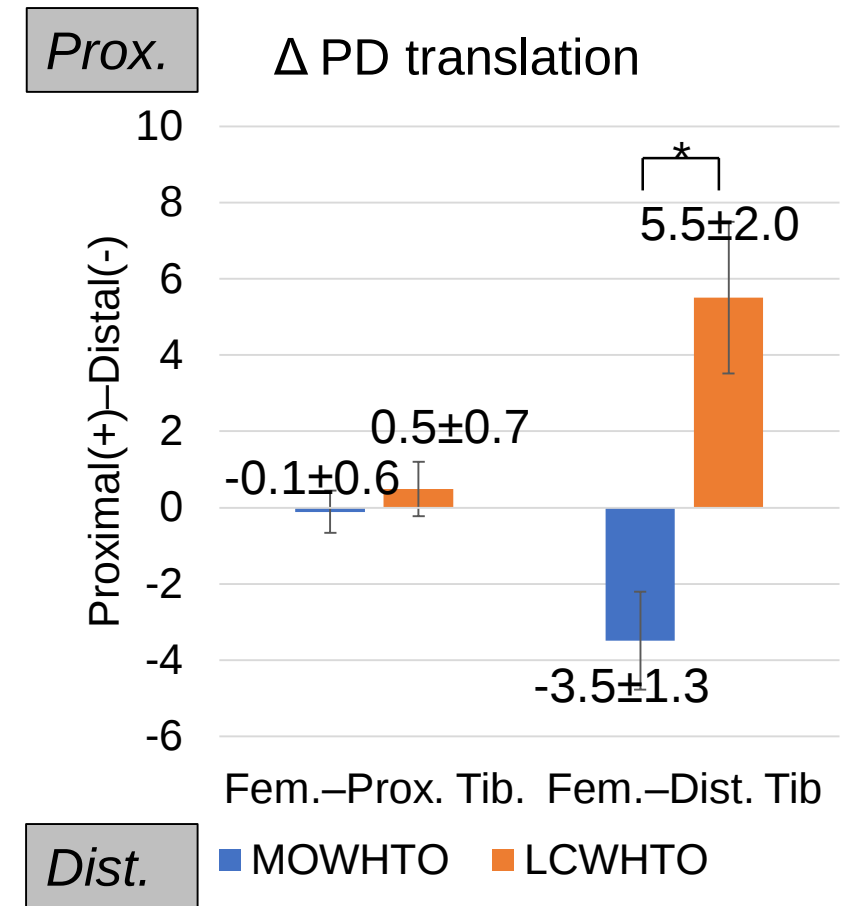
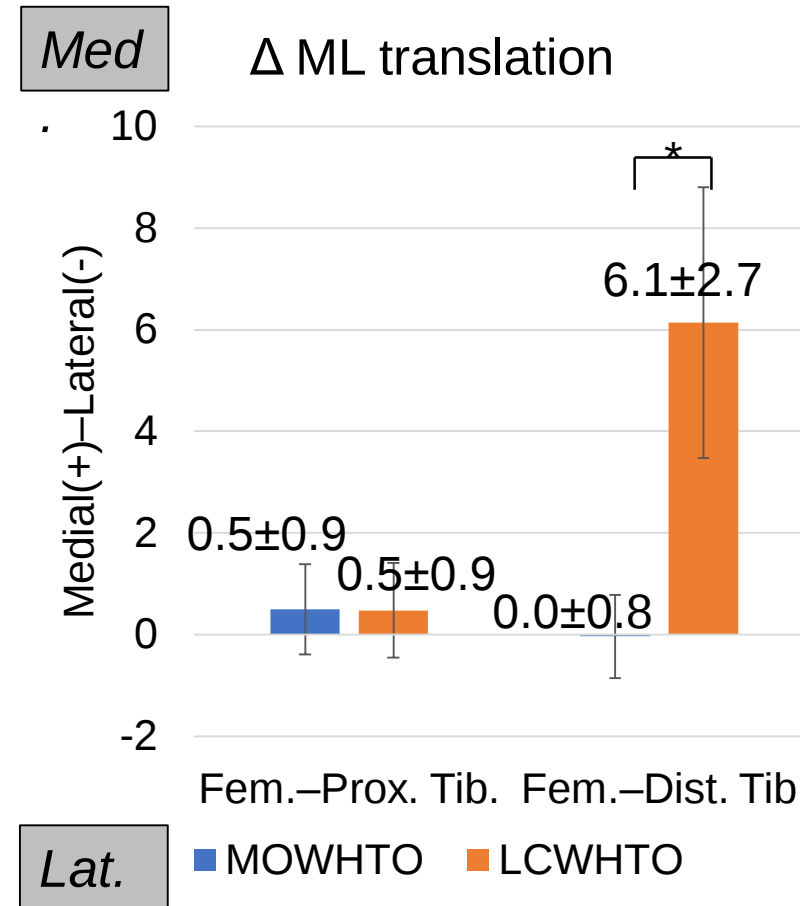
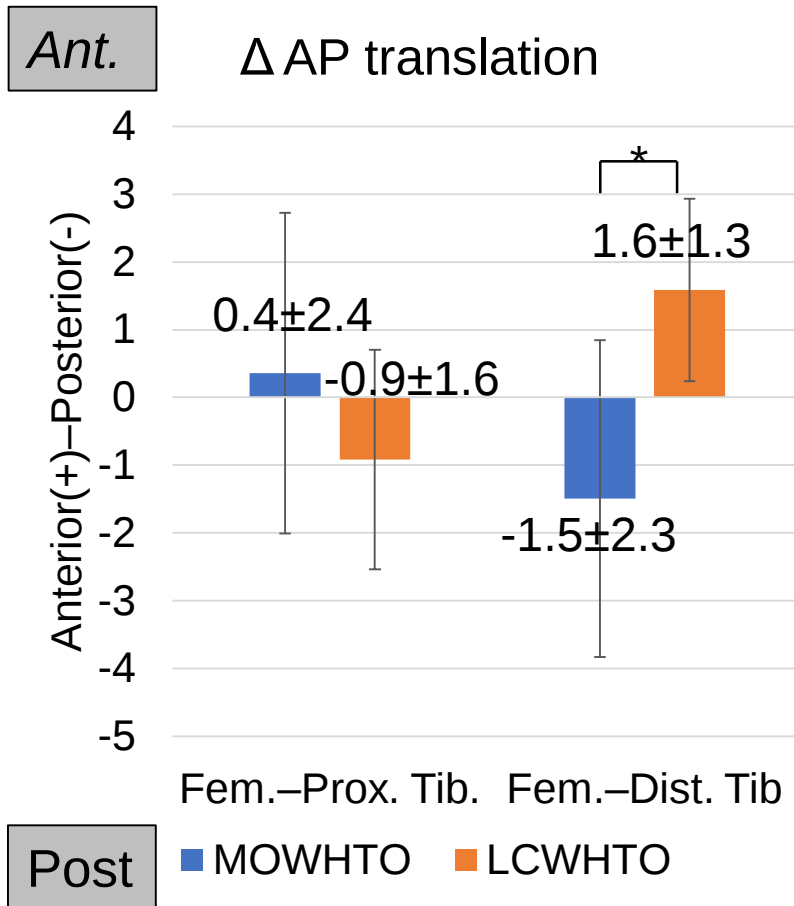
T-F relationship (tibial translation/rotation relative to femur)

- Change of T-F relationship (preop.—1-year postop.): Δ translation / Δ rotation



Δ translation

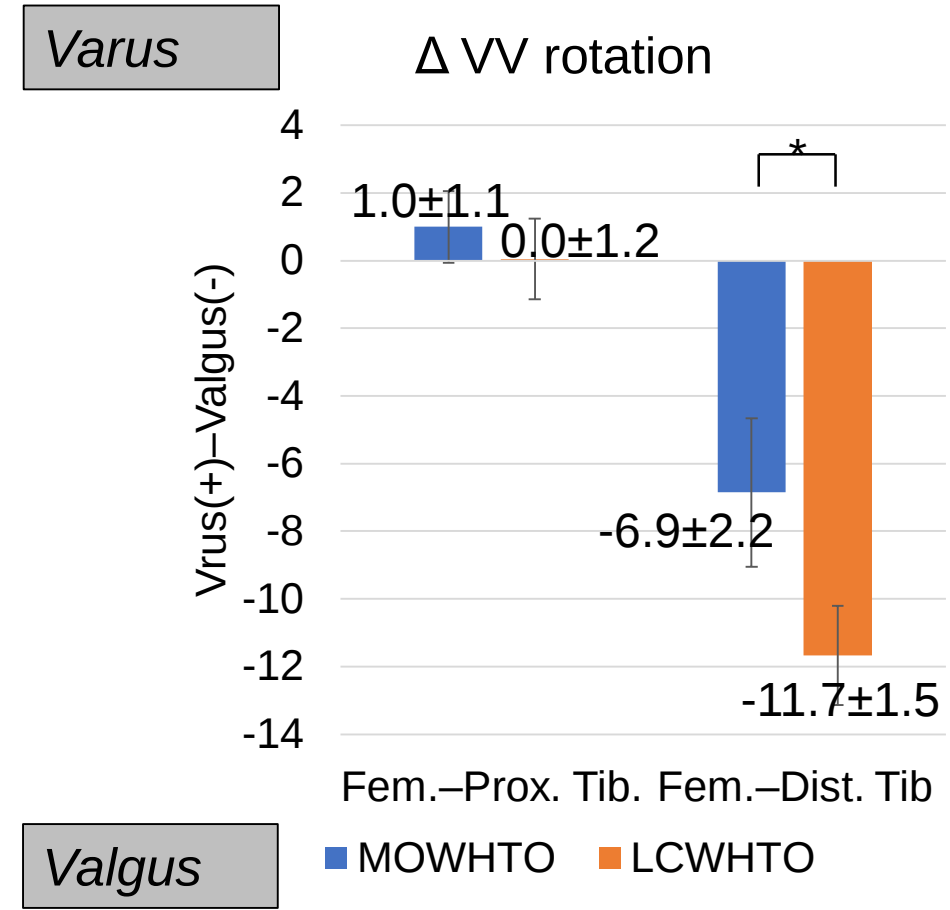
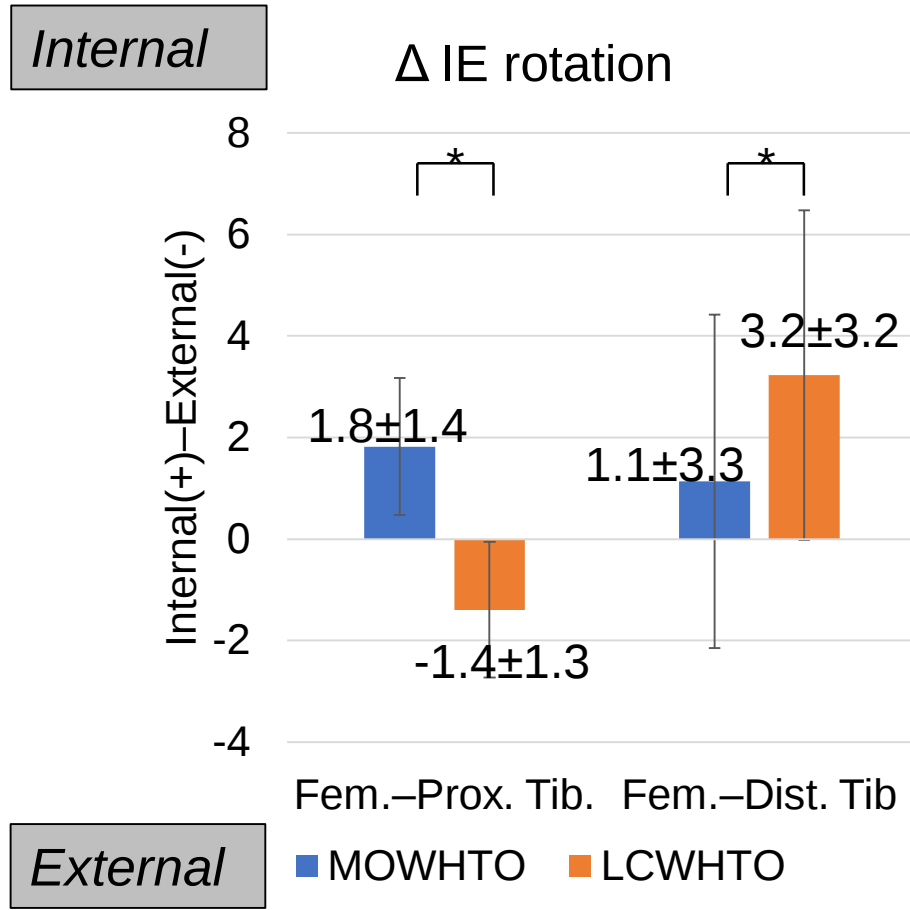
- *AP(anterior–posterior), ML(medial–lateral), PD(proximal–distal) translation*
- *Positive values = Tibial anterior/medial/proximal translation*



*: P<0.05 (Wilcoxon rank sum test)

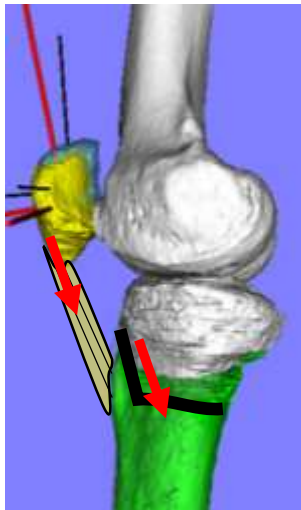
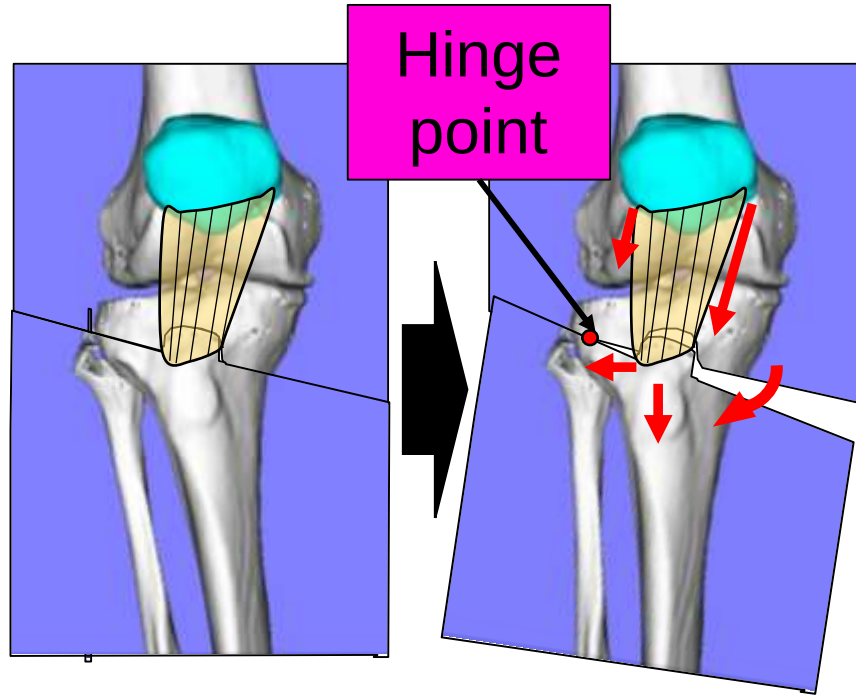
Δ rotation

- *IE(internal–external), VV(varus–valgus) rotation*
- *Positive values = Tibial internal/varus rotation*



*: $P < 0.05$ (Wilcoxon rank sum test)

Change of T-F relationship after MOWHTO



Distal tibial fragment

Distal & posterior translation

Medially-dominant
distal opening

Tibial tuberosity

Lateral translation



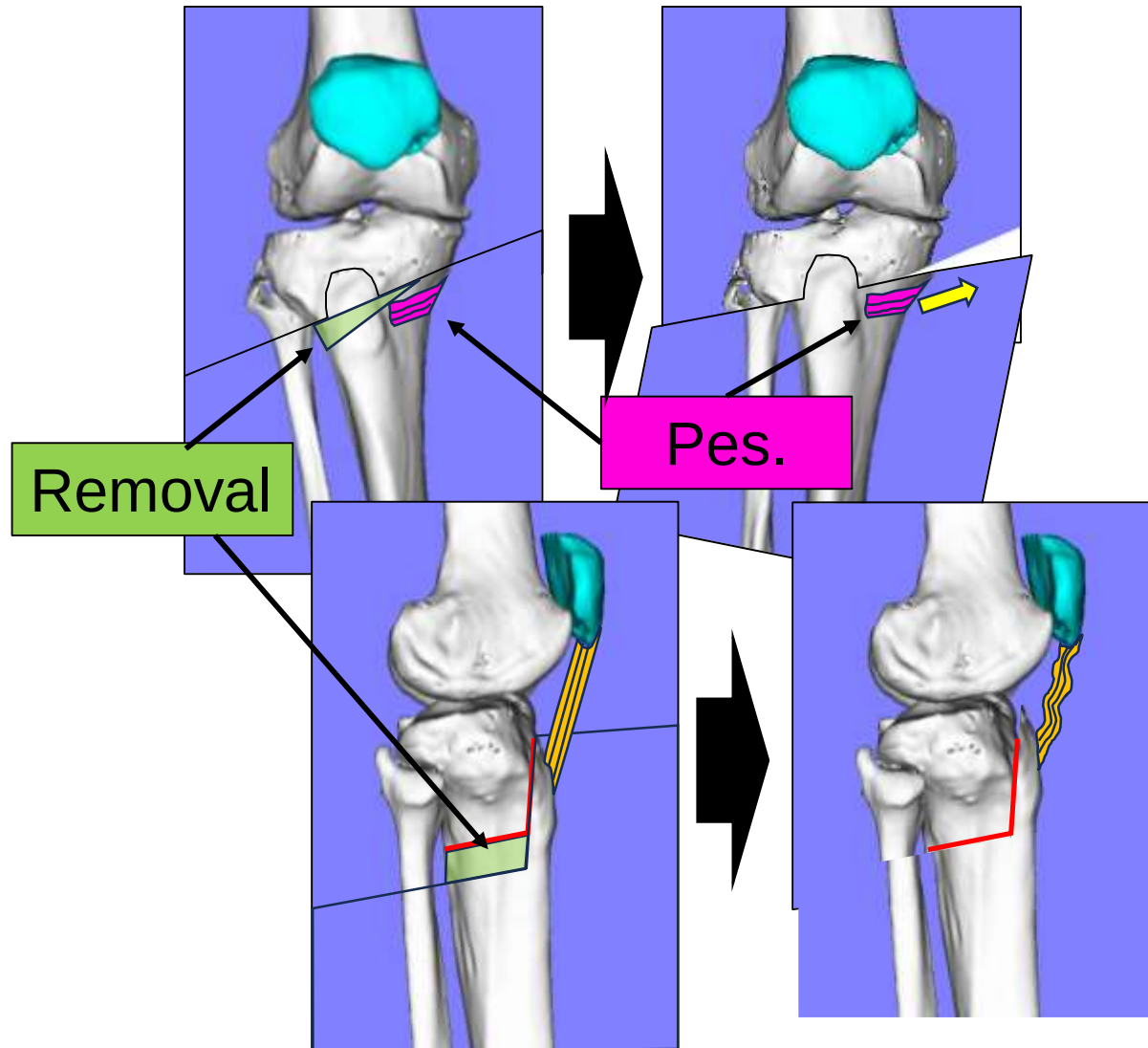
Lateral patellofemoral contact pressure↑
Patellar distal shift & valgus, internal rotation

Gaasbeek R, et al. KSSTA 2007

Entremont AG, et al. BJJ 2014

Kameda T, et al. AJSM 2021

Change of T-F relationship after LCWHTO



Distal tibial fragment
incl. tuberosity and pes anserinus

Medial & anterior & proximal shift
Internal rotation

↓
TT-TG distance ↓, Extensor relaxed



Protective for patellofemoral joint

Takeuchi R, et al. Arthrosc Tech 2014
Sadek AF, et al. Knee 2016
Kuwashima U, et al. Knee 2019
Kim II J, et al. AJSM 2020
Kikuchi K, et al. SICOT J 2024

Conclusion

LCWHTO led to anterior/medial/proximal translation and internal rotation of the distal tibial fragment including the tibial tubercle, which might be advantageous for patellofemoral joint protection.

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