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# Changes in Talus CT Values Before and After Medial Opening Wedge High Tibial Osteotomy for Knee Osteoarthritis

Yoshiharu Shimozono, MD, PhD<sup>1</sup>, Yuki Shinya, MD<sup>1</sup>, Sayako Sakai, MD<sup>1</sup>

Shinichi Kuriyama, MD, PhD<sup>1</sup>, Shuichi Matsuda, MD, PhD<sup>1</sup>

京都大学

<sup>1</sup> Kyoto University, Orthopaedic Surgery

KU:P



# **Conflict of Interest**

**Nothing to disclose**

# Introduction

- Knee OA and its surgical correction (i.e. Medial opening wedge high tibial osteotomy (OWHTO)) can alter lower limb alignment, affecting stress distribution at the ankle.
- These alignment changes may lead to subchondral bone alterations in the ankle joint.
- CT-based HU analysis enables detection of subtle subchondral bone changes, even in early stage OA



## Purpose

To evaluate how leg alignment changes by HTO for knee OA influence ankle subchondral bone stress distribution using quantitative HU measurements

# Methods

- Retrospective study (2019-2022)
- Subjects: Pts undergoing OWHTO for moderate knee OA
- Exclusion: KL grade $\geq$ 2 ankle OA, Talar OCL, Post-op complications (infection, lateral hinge fracture)
- Surgical Technique
  - OWHTO: Biplanar osteotomy, Fixation: TomoFix +  $\beta$ -TCP spacers
  - Postop rehab: 0-1 w NWB, 1-3w ROM&1/3PWB, 4w- FWB
- CT scans of the knee and ankle: Preop and 1-year postop
- Hip-knee-ankle (HKA) angle was measured

# Methods

## ROI placement and HU measurement

- **Evaluation Plane:** Coronal plane through the midpoint of anterior and posterior talar dome articular surfaces
- **ROI Setup:** 6 circular ROIs (4 mm diameter) placed equidistantly from medial to lateral (Zones 1-6)
- **Measurement Area:** Subarticular spongiosa just below the subchondral bone plate
- **HU Values:** Calculated from CT attenuation coefficients (Air = -1000, Water = 0)



# Methods

## Tibial reference ROI for HU comparison

- **Purpose:** Control for bone density changes due to postoperative non-weightbearing
- **Location:** Central tibia, just above the remnant of the distal tibial growth plate
- **ROI:** Same diameter as talar ROIs
- **Timing:** CT values compared between **preoperative and 1-year postoperative** scans

# Results

## Radiographic and CT Value Changes

49 patients with knee OA (19 M, 30 F), mean age  $61.5 \pm 7.2$  years, mean BMI  $27.9 \pm 4.7$

- **HKA Angle**

- Pre-op:  $173.5^\circ \pm 3.5 \rightarrow$  Post-op:  $181.8^\circ \pm 2.4$  (**P < 0.01**)

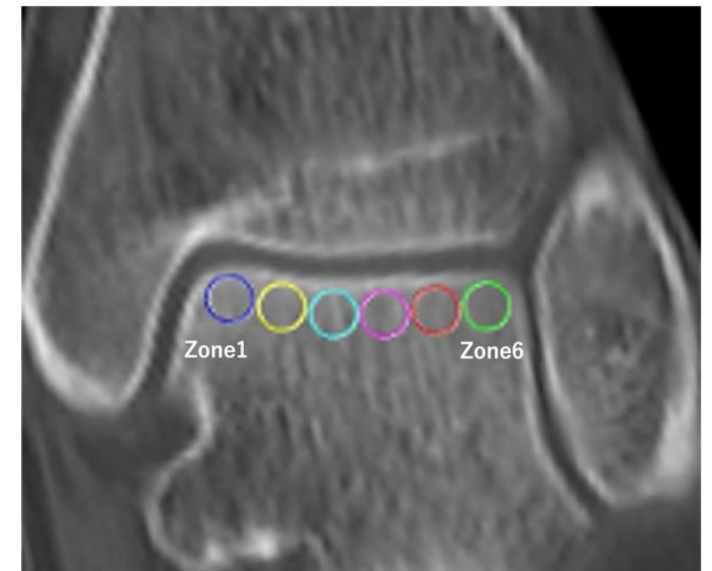
- **CT Values by ROI (Zones 1–6)**

- Zone 1:  $\downarrow 744.7 \rightarrow 690.2$  HU (**P < 0.01**)
- Zone 6:  $\downarrow 634.5 \rightarrow 608.8$  HU (**P < 0.01**)
- Zones 3–4: Slight  $\uparrow$  (not significant)
- Medial > Lateral > Central (Pre & Post)

CT value (HU)	Pre-op	Post-op	
Zone 1	$744.76 \pm 114.16$	$690.25 \pm 124.53$	<0.01
Zone 2	$635.83 \pm 105.51$	$622.70 \pm 123.41$	NS
Zone 3	$580.86 \pm 115.83$	$589.00 \pm 135.87$	NS
Zone 4	$585.12 \pm 120.65$	$590.77 \pm 127.17$	NS
Zone 5	$612.83 \pm 117.85$	$604.87 \pm 106.93$	NS
Zone 6	$634.56 \pm 112.26$	$608.82 \pm 103.76$	<0.01

# Results: Correlations

- **Zone 1**
  - Positive correlation between **pre-op HKA angle** and **HU change**
  - $\rho = 0.34$ ,  $P = 0.017$
- **Zone 5**
  - Negative correlation between  **$\Delta$ HKA** and  **$\Delta$ HU**
  - $\rho = -0.27$ ,  $P = 0.062$  (not significant)





# Results: Reference Tibial CT value

- No significant difference in tibial ROI HU values:
  - **Pre-op:**  $266.2 \pm 56.0$  HU
  - **Post-op:**  $256.7 \pm 65.5$  HU
  - $P = 0.277$
- → Suggests that NWB periods did not affect bone density, supporting that talar HU changes reflect alignment correction effects.

# Discussion

- OWHTO changed talar subchondral density, mainly in medial/lateral zones
- **Zone 1:** Greater correction → larger HU decrease
- Reflects stress shift via kinetic chain (Wolff's law)
- CT values offer objective evidence of bone adaptation
- Medial unloading suggests partial reversibility of varus stress
- Overcorrection may cause ankle pain → careful planning essential
- **Limitations:** retrospective, no normative CT, coronal-only, short follow-up

# Conclusion

- OWHTO significantly alters CT values in the talar subchondral bone, especially medially.
- Indicates redistribution of ankle joint loading after realignment.
- Highlights the potential of OWHTO to influence ankle joint mechanics.
- Further studies needed to assess long-term effects on joint health and function.