

# Effects of a medial opening-wedge distal tibial osteotomy using hemicallotasis (OWDTO-HCO) on articular cartilage of the proximal tibiofibular joint

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# Financial Disclosure Statement

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**I DO NOT have a financial interests or other relationship  
with any commercial company related directly or indirectly  
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# Medial opening-wedge distal tibial osteotomy using hemicallotasis (OWDTO-HCO)

Medial opening-wedge high tibial osteotomy is a widely accepted procedure for the treatment of medial compartment arthritis of the knee. However, this procedure has some disadvantages including the cartilage degeneration in the patellofemoral joint<sup>1-3</sup> and the increase of sagittal tibial slope<sup>4,5</sup> because of a supra-tubercle osteotomy. With the aim of avoiding these potential problems, some authors support a medial opening-wedge infra-tubercle osteotomy, i.e. distal tibial osteotomy (OW-DTO)<sup>6-8</sup>. In the OW-DTO, the fibular osteotomy is not necessary as well. We have performed a medial opening-wedge distal tibial osteotomy using hemicallotasis (OWDTO-HCO) as an option of OW-DTO until now, without fibular osteotomy<sup>9, 10</sup>. However, the effect of this OWDTO-HCO on the proximal tibiofibular joint (PTFJ) is not clear.

## Pre-op.



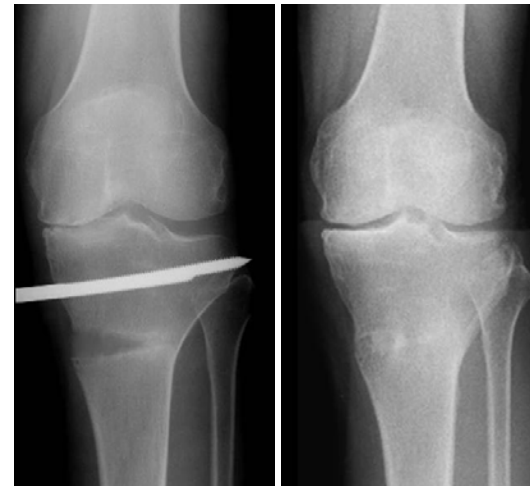
## Operation

Setting an external fixator on the medial aspect of the tibia



## Postop.

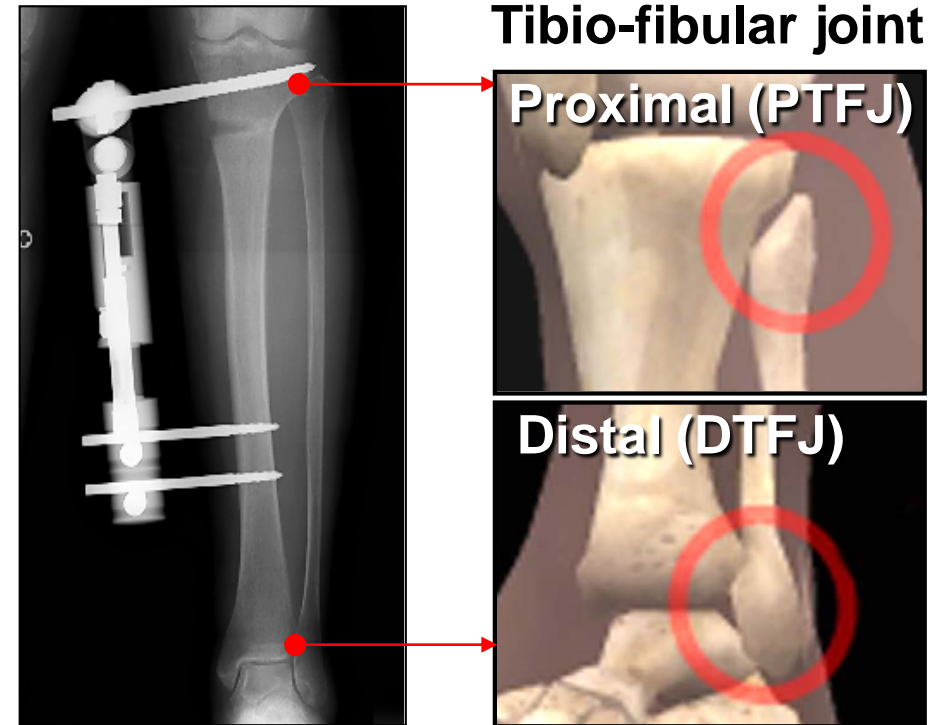
Medial opening at the distal tibial osteotomy site using distraction osteogenesis



# Purpose

The purpose of this study are

- 1) to examine the effects of HCO on the articular cartilage of proximal tibio-fibular joint (PTFJ) based on the analysis using a quantitative T1 $\rho$  magnetic resonance imaging (MRI), and
- 2) to clarify the relationship between the CA and the articular cartilage change of PTFJ.



# Patient profiles and Methods

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<b>Patients (knees)</b>	<b>: 20 (20)</b>
<b>Desease</b>	<b>: medial OA of the knee</b>
<b>Gender</b>	<b>: 5 male (5 knees)</b> <b>15 females (15 knees)</b>
<b>Age at surgery</b>	<b>: avg. 70 y.o. ( 53 - 74 y.o. )</b>

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## All patients underwent

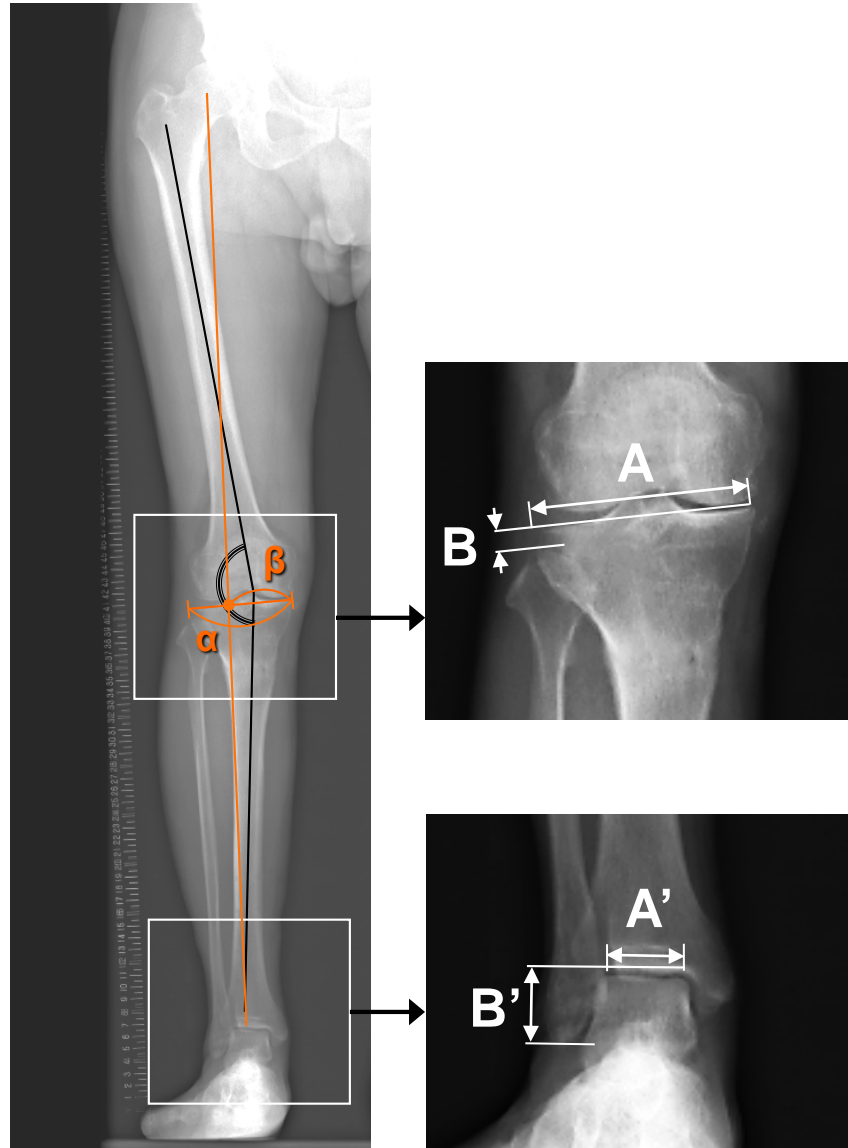
- **OWDTO-HCO without fibulectomy**

The correction angle was planned so that Mikulicz line would pass through a point approximately 65 - 70% of the distance from the medial edge of the proximal tibial plateau on a standing AP radiograph.

- **X-ray and MRI evaluations pre-operatively and at one year after surgery**

# Radiographic evaluation

Weight-bearing full-length hip-to-ankle scanogram using a image-intensifier and digital flat panel detector



## ● Parameters

① **FTA (°)**

② **%Mechanical Axis (%MA)**  
 $= \beta/\alpha \times 100 (\%)$

③ **Height of the fibular head**  
 $= B/A \times 100 (\%)$

④ **Height of the distal fibular end**  
 $= B'/A' \times 100 (\%)$



# MRI evaluation

## ■ MR imaging protocol :

- **Scanner** : a 3-Tesla (Achieva 3T, Philips)
- **Sequence** : **3D WATS** (3D T1w. fast field echo with water-selective excitation)  
**T1 $\rho$**

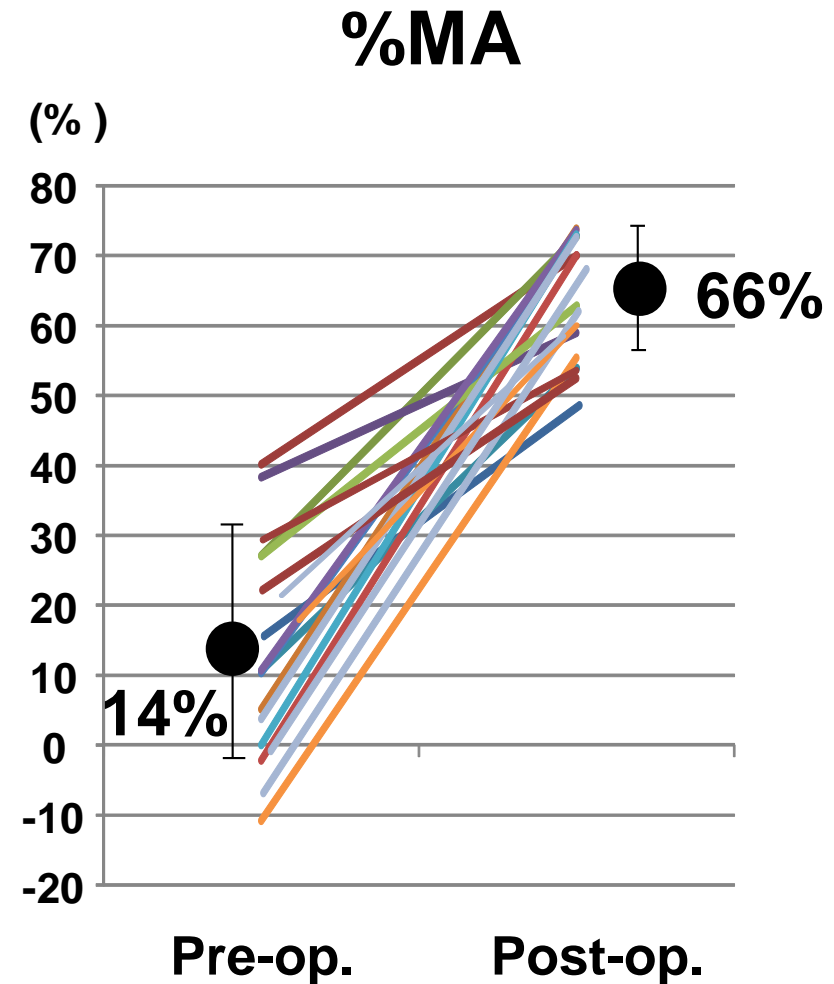
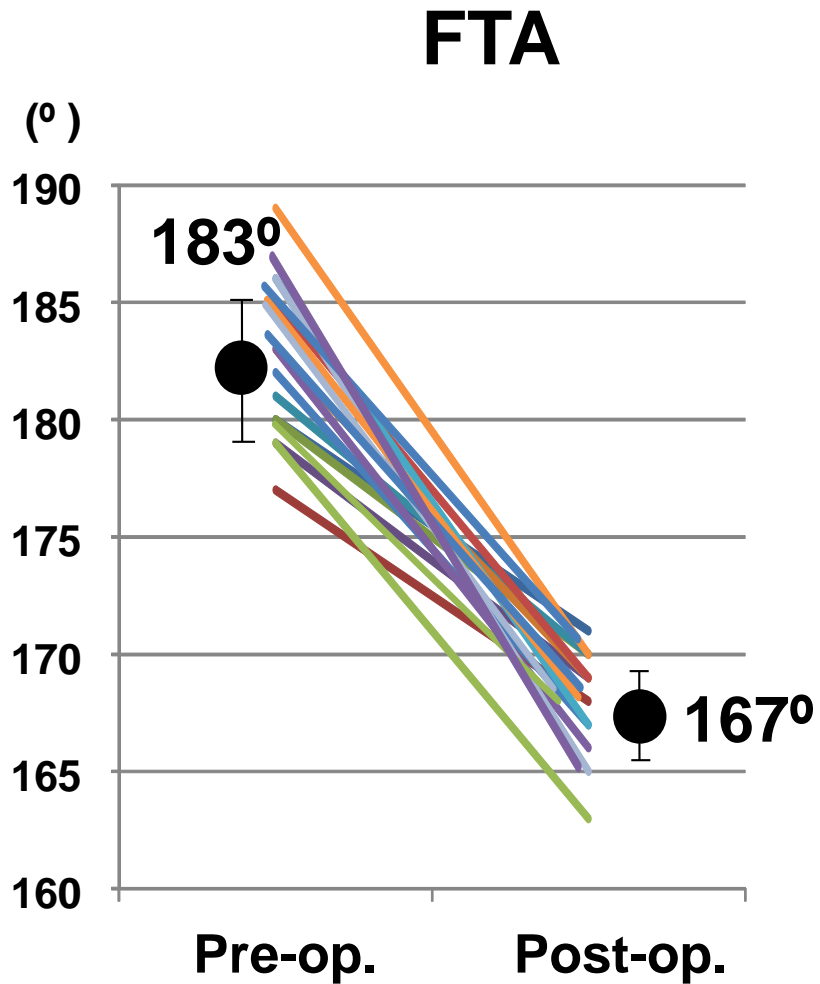
Sequence	3D WATS	T1rho
Repetition time (ms)	10	4.7
Echo time (ms)	4.7	2.3
Field of view (mm)	140 × 140	140 × 140
Matrix	400 × 400	320 × 320
Thickness	4mm	4mm
Flip angle (° )	20	35
TSL (ms)		1, 10, 20, 30, 40

- **Construction of T1 $\rho$  mappings using PRIDE software (Philips)**
- **Setting of ROI on the full thickness cartilage in PTFJ**
- **Measurement using Image J software (NIH)**



**ROI on the full thickness cartilage in PTFJ**

# Changes in the FTA and %MA

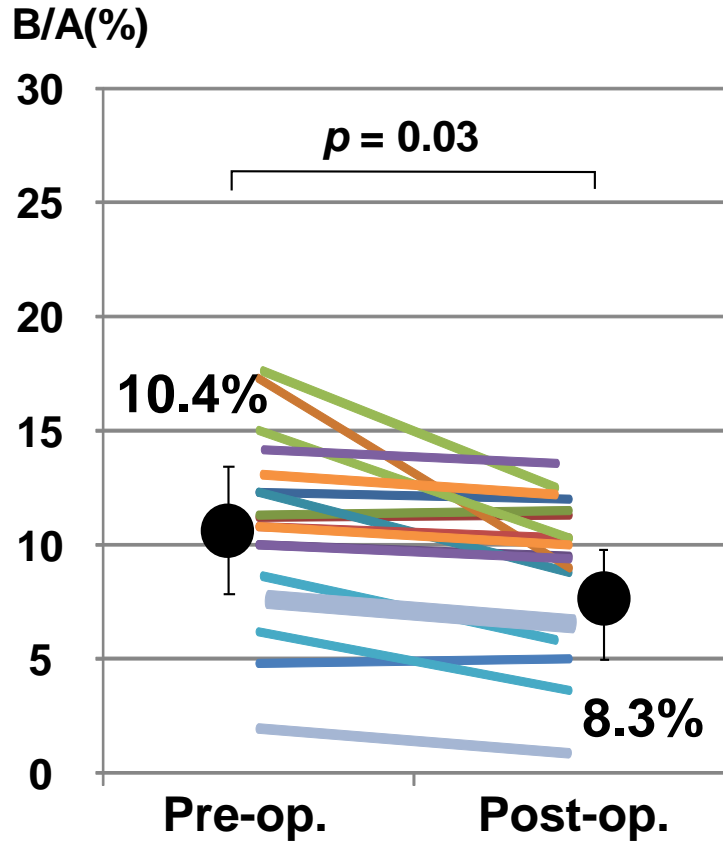


CA = Avg. 15° ( 9° ~21° ) : Seven out of 20 knees had the CA more than 15°

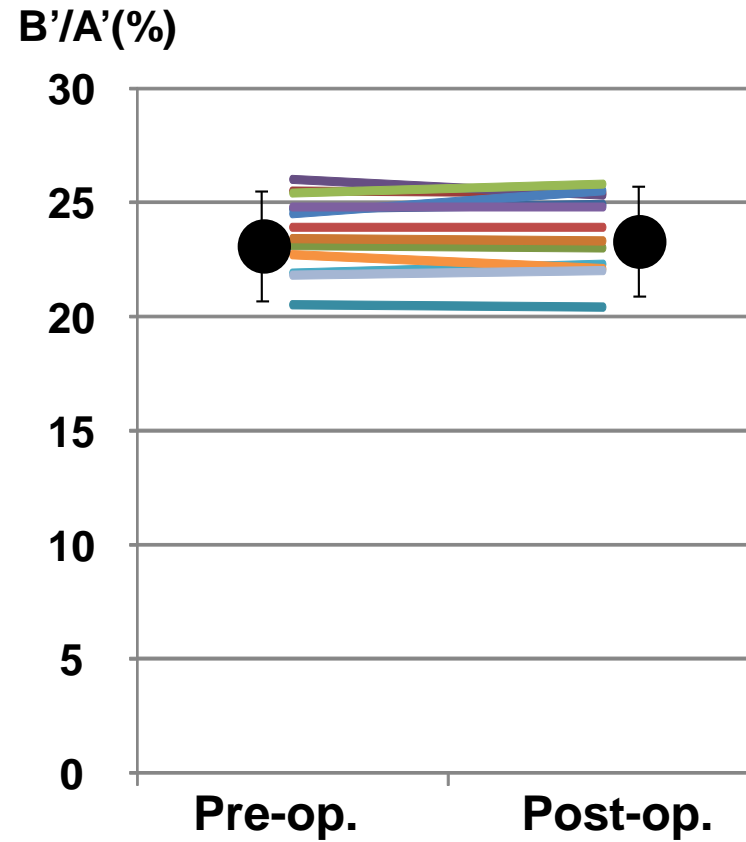


# Changes in the coronal position of the fibular head and the distal fibular end

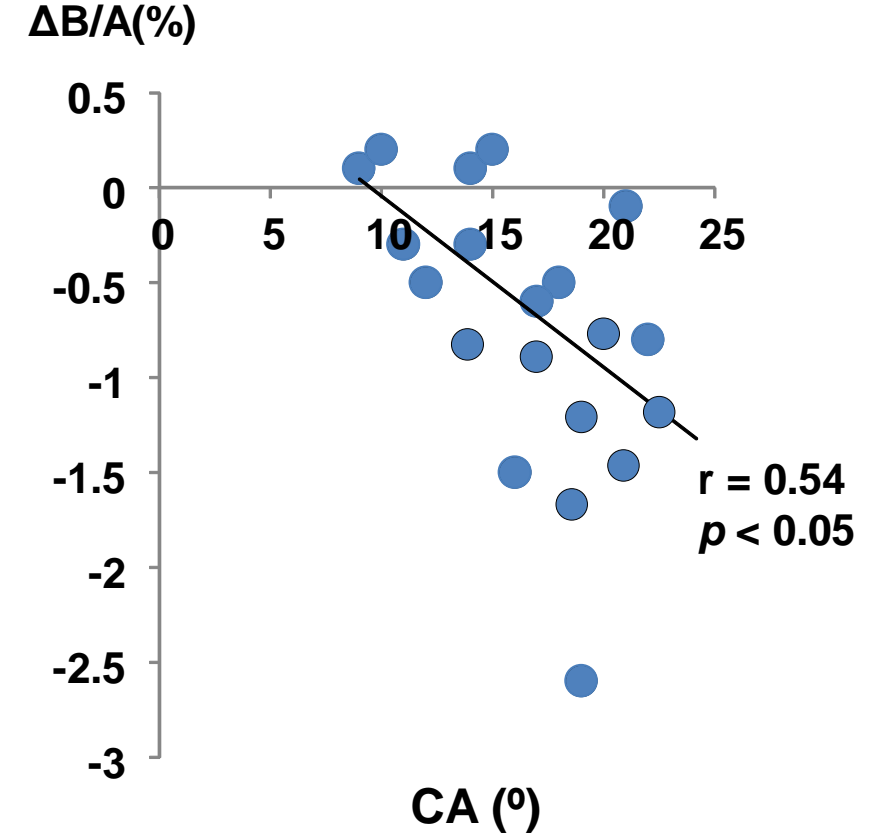
## Height of the fibular head



## Height of the distal fibular end

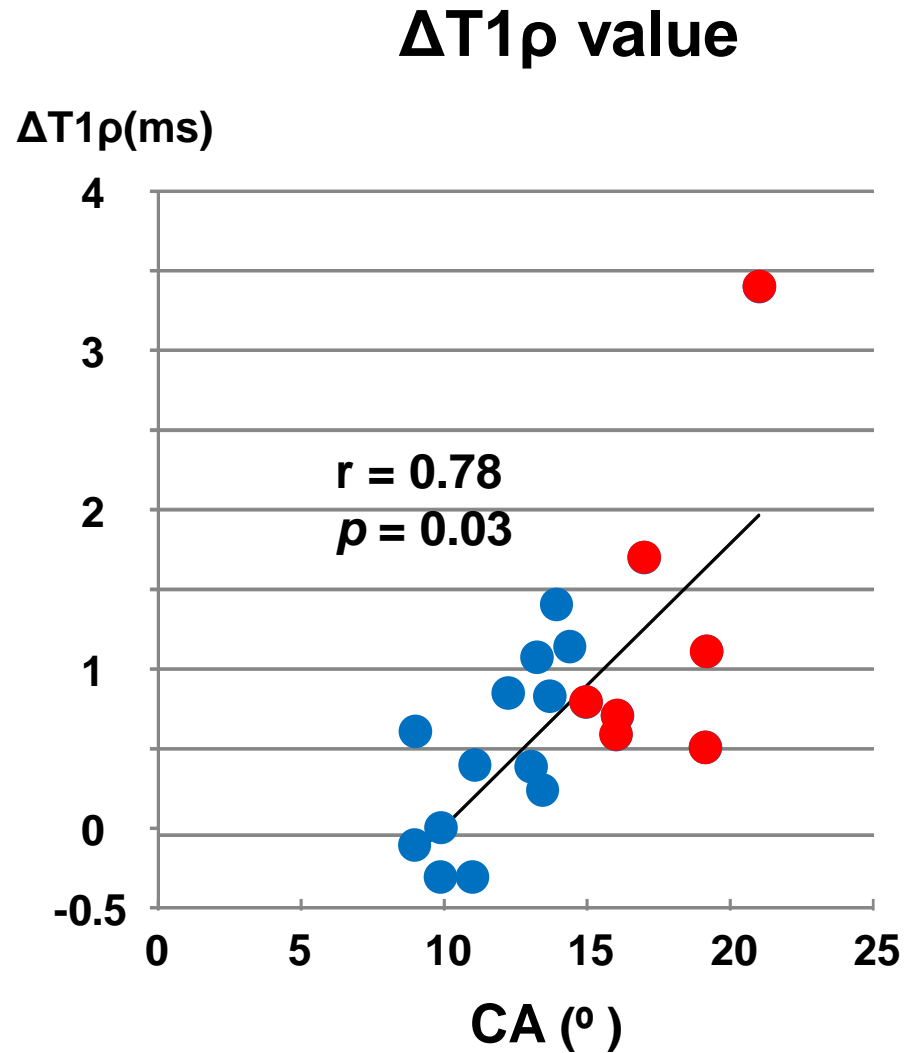
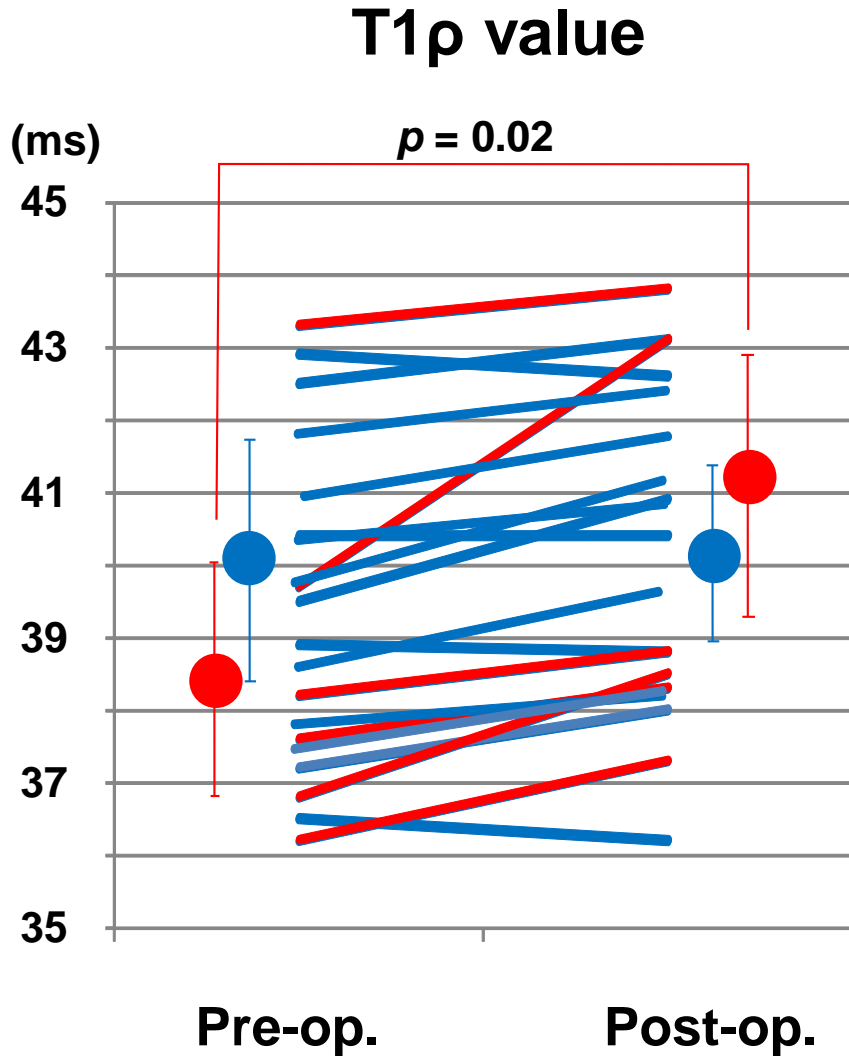


## Relationship between $\Delta B/A$ and CA



In all knees, the fibular head was displaced upward postoperatively, while the position of the distal tip of the fibula was not changed. The upward transposition of the fibular head showed a positive correlation with increase of CA

# Change in T1 $\rho$ relaxation times on PTFJ



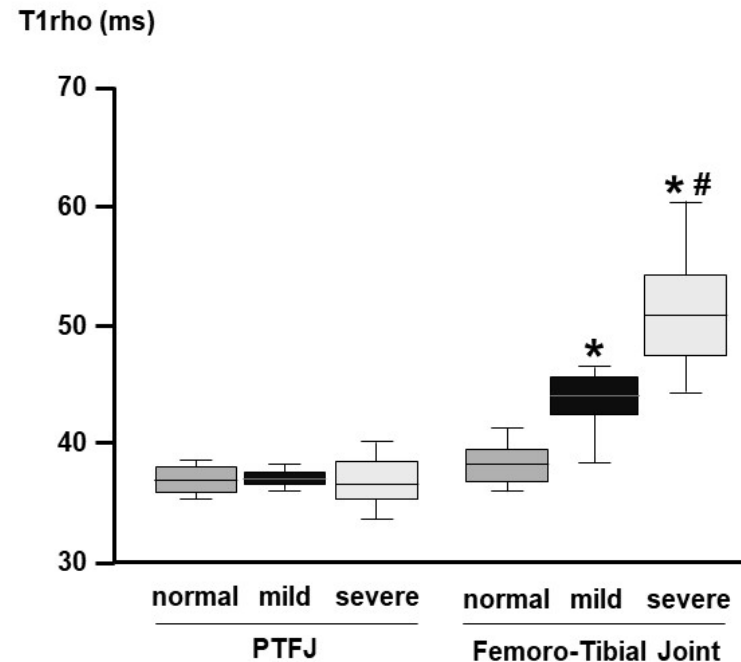
In the knees with CA less than 15°, the averaged T1 $\rho$  relaxation time was 40.1 millisecond (ms) pre-operatively, and 40.3 ms at one-year after surgery, showing no significant postoperative change. On the other hand, those with CA more than 15° had 38.4 ms pre-operatively, and 41.4 ms at one-year after surgery, which showed the significant higher post-operative value (Mann-Whitney U test,  $p=0.02$ ). A significant correlation between CA and the amount of post-operative increase in T1 $\rho$  relaxation time was found ( $r=0.78$ ,  $p=0.03$ ).

# Discussion

In OWDTO-HCO without fibular osteotomy, the fibular head was displaced more upward as the CA increased. T1 $\rho$  mapping has been reported a sensitive noninvasive marker for quantitatively predicting and monitoring the status of macro-molecules in early OA. In the previous study<sup>11</sup>, we showed that the T1 $\rho$  relaxation time of PTFJ cartilage were not affected by aging or cartilage degeneration in the femorotibial joint, and those value showed a constant range from 35 ms to 40 ms. Accordingly, our results suggested that the PTFJ cartilage might have a degenerative change post-operatively if we perform the tibial valgus correction more than 15° using the OWDTO-HCO with no fibular osteotomy.

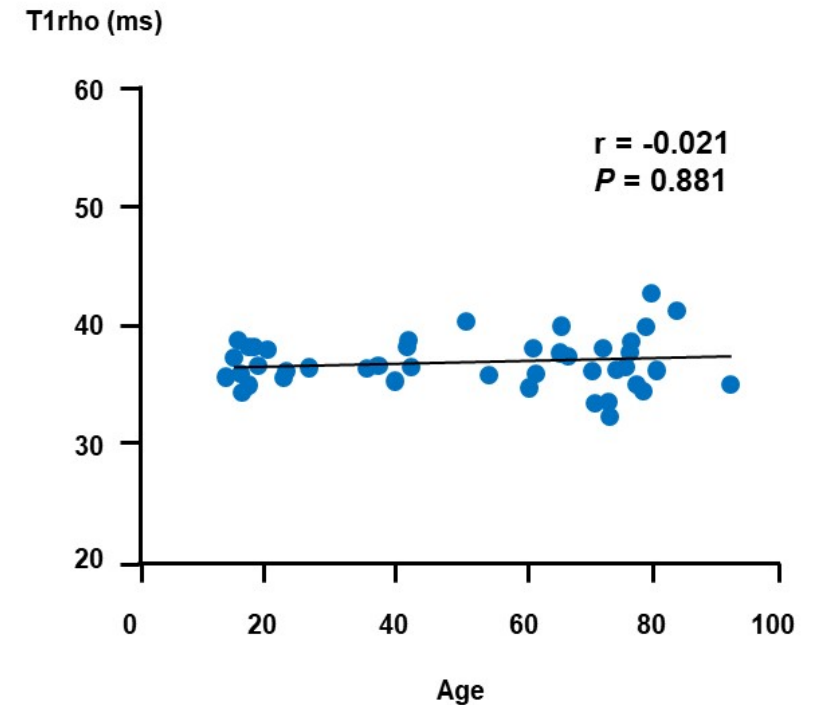
## T1 $\rho$ value of the articular cartilage of PTFJ

OA grade and T1 $\rho$  value



# P < 0.05 vs normal  
\* P < 0.05 vs Kellgren-Lawrence分類 mild by ANOVA with Tukey's HSD test

Correlation between age and T1 $\rho$  value



# Summary

- 1. In the 20 OWDTO-HCOs, we investigated the effects of HCO on the PTFJ cartilage based on the analysis using a quantitative T1 $\rho$  mapping in order to clarify the relationship with the CA.**
- 2. The upper transposition of the fibular head occurred as the increase of CA. In the knees with CA less than 15 $^{\circ}$ , the averaged T1 $\rho$  relaxation time was 40.1 ms pre-operatively, and 40.3 ms at one-year after surgery, showing no significant postoperative change. On the other hand, those with CA more than 15 $^{\circ}$  had 38.4 ms pre-operatively, and 41.4 ms at one-year after surgery, which showed the significant higher post-operative. A significant correlation between CA and the amount of post-operative increase in T1 $\rho$  relaxation time was found.**
- 3. Our results suggested that the PTFJ cartilage might have a degenerative change post-operatively if we perform the tibial valgus correction more than 15 $^{\circ}$  using the OWDTO-HCO with no fibular osteotomy.**

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***Thank you for your kind attention***