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Alteration of Stress Distribution Patterns Across the Patellofemoral Joint After Neutral Wedge High Tibial Osteotomy: An Evaluation Using Computed Tomography Osteoabsorptiometry

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I have no financial conflicts to disclose.

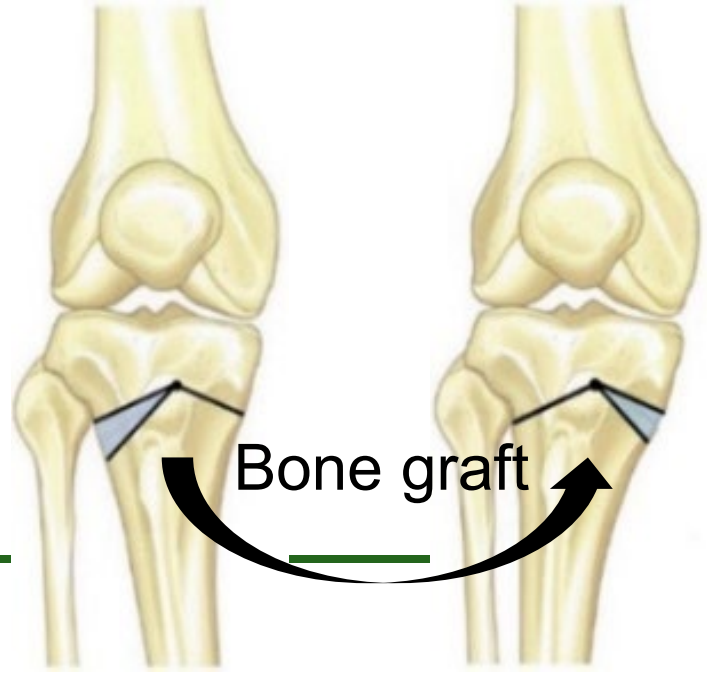
Introduction

- Inverted V-shaped (iV) HTO, which was classified as a neutral-wedge (NW) (hemi-closing wedge and hemi-opening wedge) osteotomy, does not distalized the position of the tibial tuberosity.

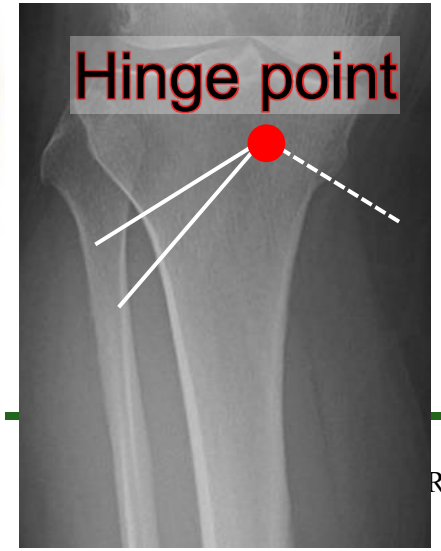
Kondo et al. Arthrosc Tech. 2018

✓A hinge point of NWHTO is located at the medial edge of the tibial tuberosity.

- Therefore, NWHTO might not have a harmful effect on the PF joint compared with OWHTO.



Pre-op

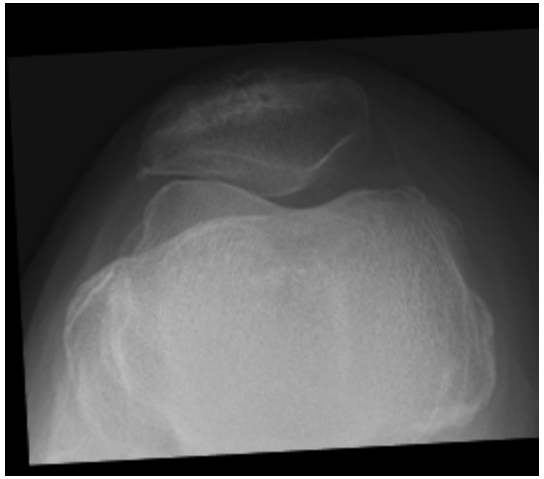


Post-op

Purpose

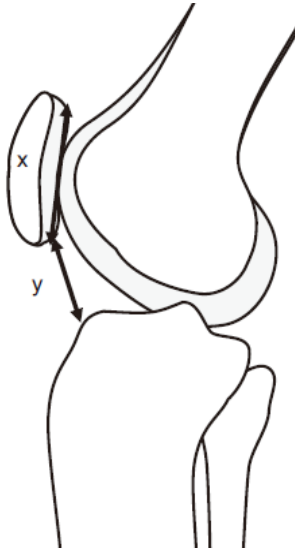
- To investigate the stress distribution pattern on the PF joint after NWHTO.



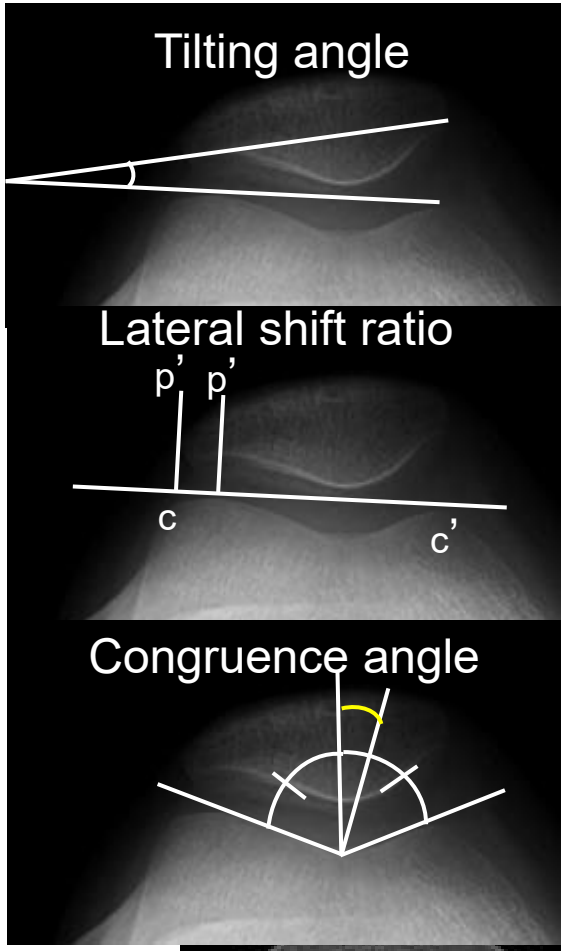


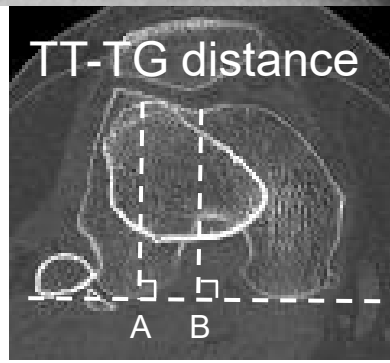

Methods

- A retrospective, comparative study (2016-2019)
  - ✓12 patients (16 knees)
    - 6 men and 6 women w/ a mean age of 59 (46–72) yrs
      - – 14 knees: medial osteoarthritis
      - – 2 knees: spontaneous osteonecrosis of the kne
- Radiographic and CT evaluations
  - ✓Xray Caton-Deschamps index (CDI)
    Tilting angle (TA)
    Lateral shift ratio (LSR)
    Congruence angle (CA)
  - ✓CT Tibial tuberosity-trochlear groove (TT-TG) distance
    The distribution map of subchondral bone density



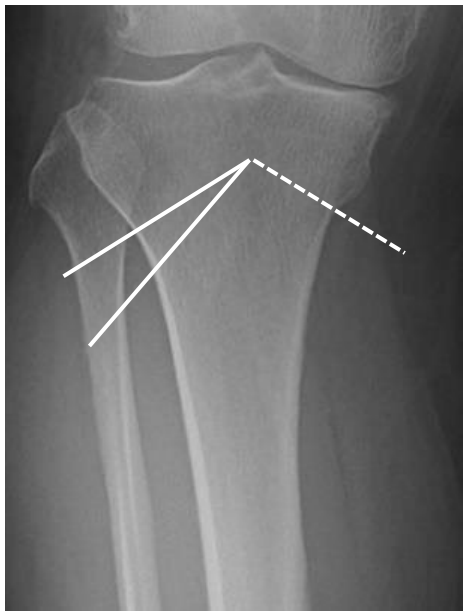
Caton-Deschamps index





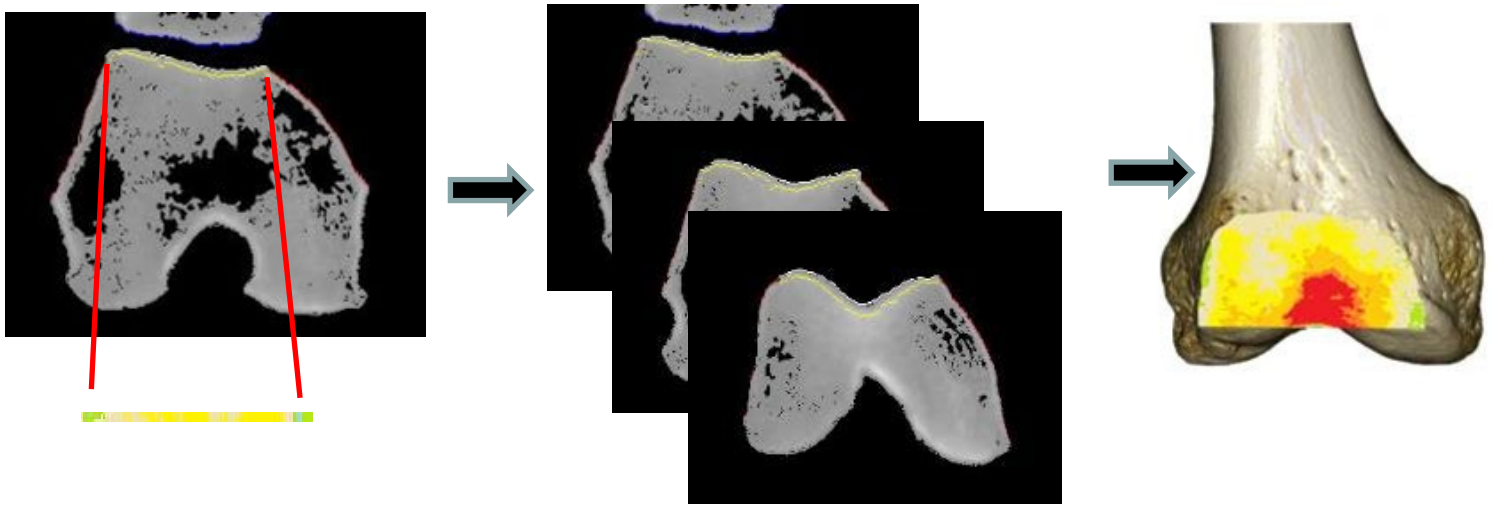
Methods

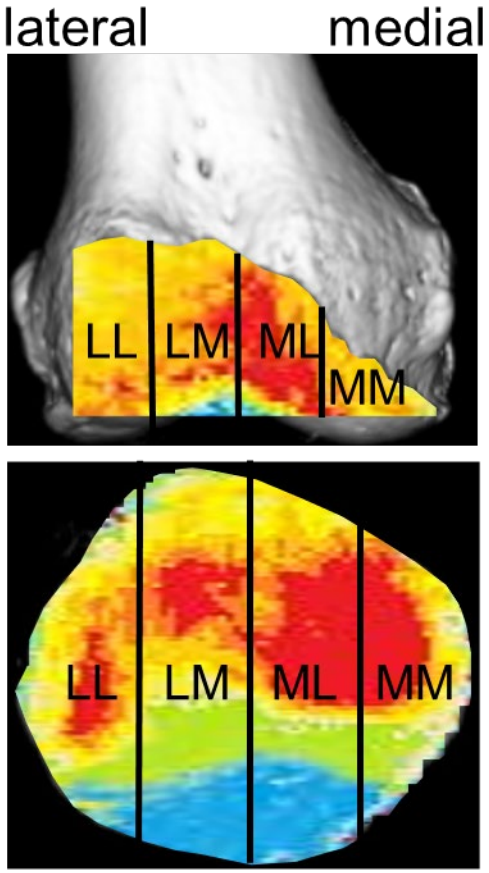
- Surgical procedure of inverted V-shaped HTO
  - ✓ fibula：long oblique osteotomy
  - ✓ Apex point：medial edge of the tibial tubercle
  - ✓ Lateral osteotomy with the wedge cutting guide
  - ✓ Medial osteotomy
  - ✓ The locking plate fixation after valgus correction



CT-Osteoabsorptiometry

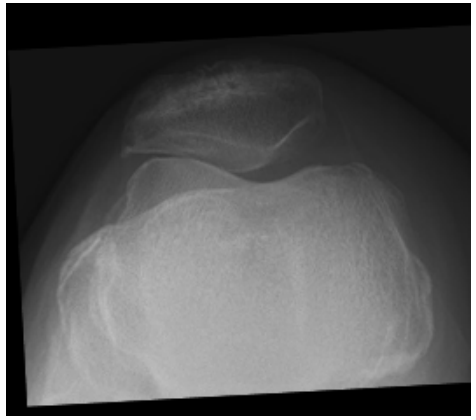
- The distribution map of subchondral bone density was created by stacking axial slices.
- Articular surface of femoral trochlea and patella were divided to four sub-regions from lateral to medial.
- The quantitative analysis of the obtained mapping data focused on location of the high-density area (HDA) through the articular surface.
- HDA was defined as 30% highest density area.
- The percentage of each subregion represented by the HDA was calculated (%HDA).





Results -Patient demographics-

- Pre-operative PF-OA
  - ✓ Stage Ⅰ : 10
  - ✓ Stage Ⅱ : 6



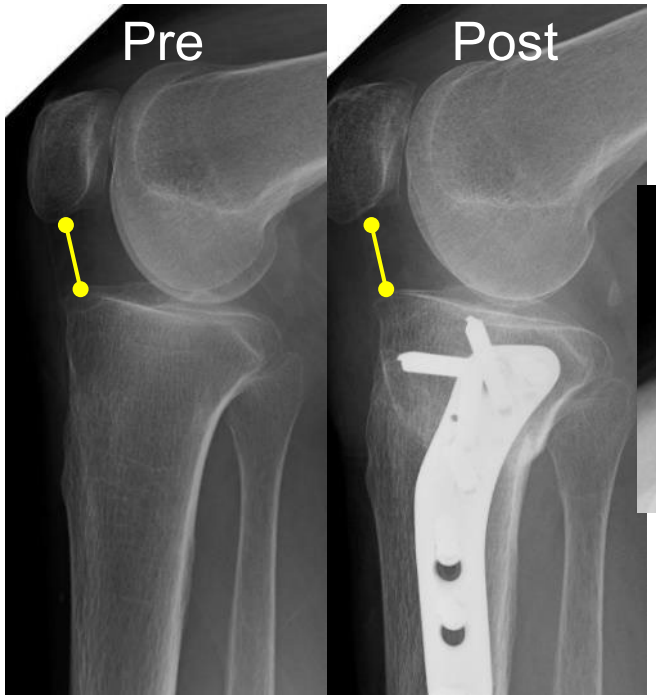
- Correction angle : 13.5 (9-23)°

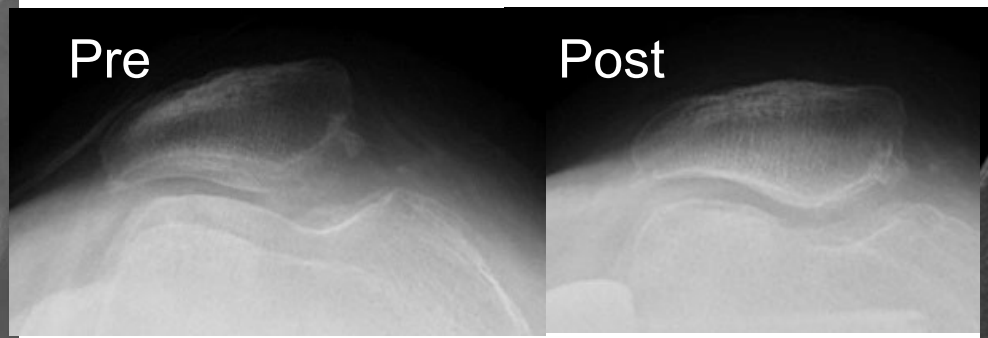
		Pre	Post	*p value*
HKA	(°)	-8.8 (3.4)	3.0 (3.9)	*< 0.001*
FTA	(°)	182.6 (3.5)	171.3 (4.0)	*< 0.001*
Mechanical axis	(%)	12.2 (14.1)	62.4 (15.1)	*< 0.001*
MPTA	(°)	82.6 (3.3)	92.5 (3.0)	*< 0.001*
PTS	(°)	8.4(2.6)	8.0(3.2)	*NS*

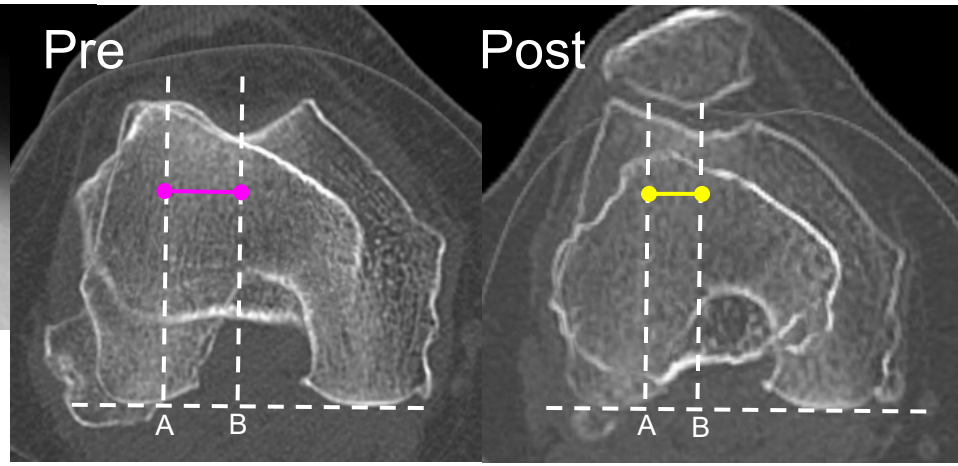
Results -Radiological assessment-

		Pre	Post	*p* value
Caton-Deschamps index		0.80 (0.10)	0.82 (0.09)	NS
Tilting angle	(°)	10.7 (5.4)	8.5 (5.0)	0.004
Lateral shift ratio	(%)	15.4 (4.3)	10.7 (5.4)	0.004
Congruence angle	(°)	0.6 (8.0)	-1.8 (6.6)	NS
TT-TG distance	(mm)	14.5 (3.4)	12.3 (2.6)	0.017

Mean (SD)
NS, not significant

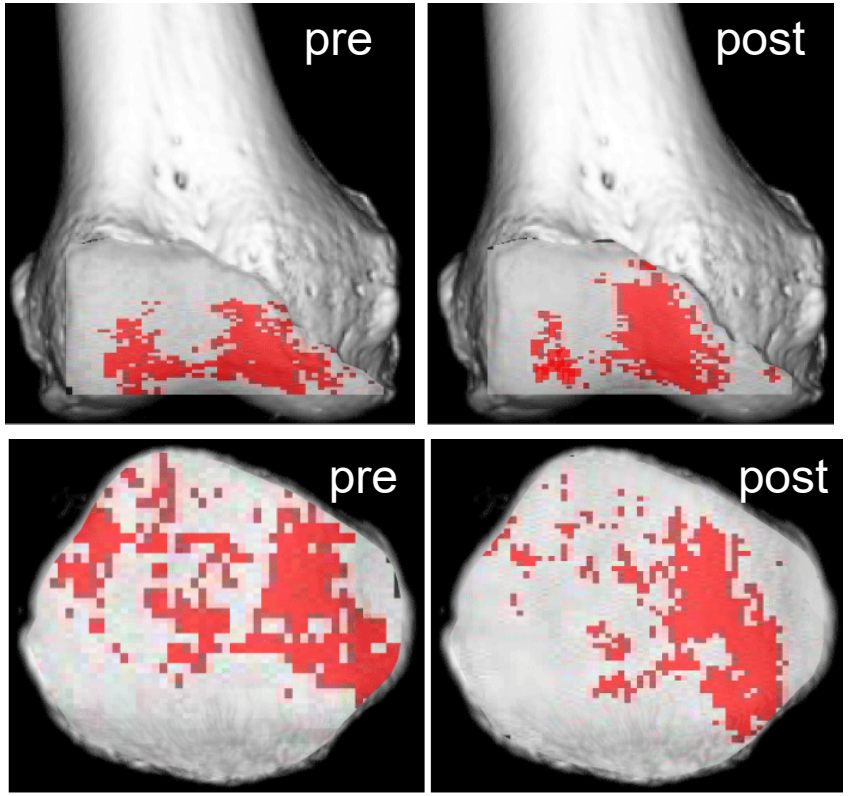






Results -%HDA assessment-

		Pre	Post	*p value*
Trochlea	LL	10.8 (12.0)	9.4 (15.5)	*NS*
	ML	12.7 (11.6)	16.3 (16.5)	*NS*
	LM	40.7 (17.0)	25.2 (23.0)	*NS*
	MM	21.2 (12.1)	15.5 (19.5)	*NS*
Patella	LL	32.6 (18.1)	19.4 (14.9)	*0.022*
	ML	35.6 (20.3)	21.9 (14.6)	*0.026*
	LM	17.7 (17.3)	15.0 (10.7)	*NS*
	MM	10.4 (13.7)	8.9 (9.0)	*NS*

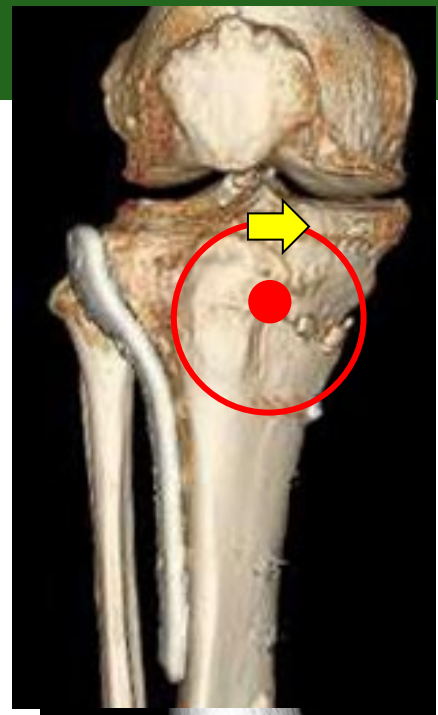


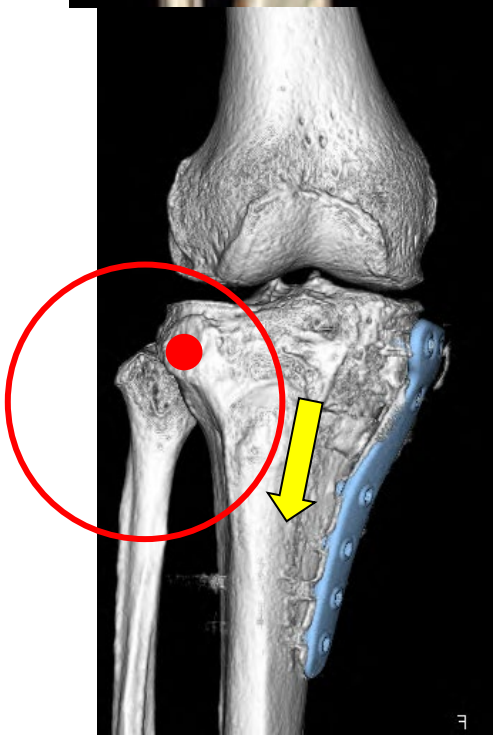
Mean (SD)
NS, not significant

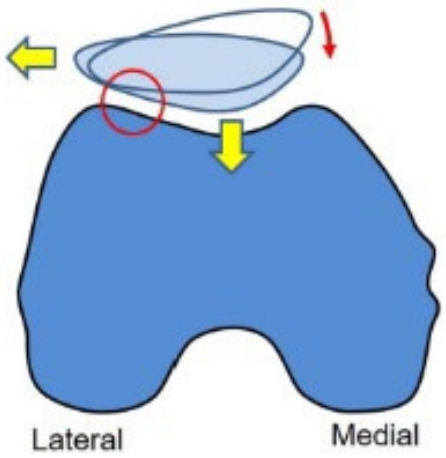
%HDA in the patellar LL and LM region significantly decreased after NWHTO

Discussion

- This study clearly demonstrated that the NWHTO significantly decreased stress distribution patterns of the lateral facet of the patella.
  - ✓ The tibial tuberosity was thought to move anteriorly and medially after NWHTO.
- On the other hand, OWHTO significantly increased the stress distribution pattern of the lateral trochlea of the femur and the medial portion of the lateral facet of the patella. *Kameda et al. Orthop J Sports Med. 2021*
  - ✓ The tibial tuberosity was thought to move distally and laterally after OWHTO.



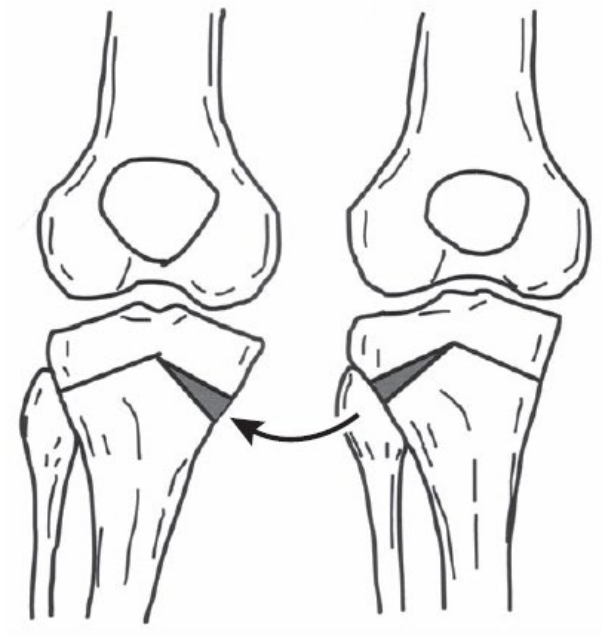


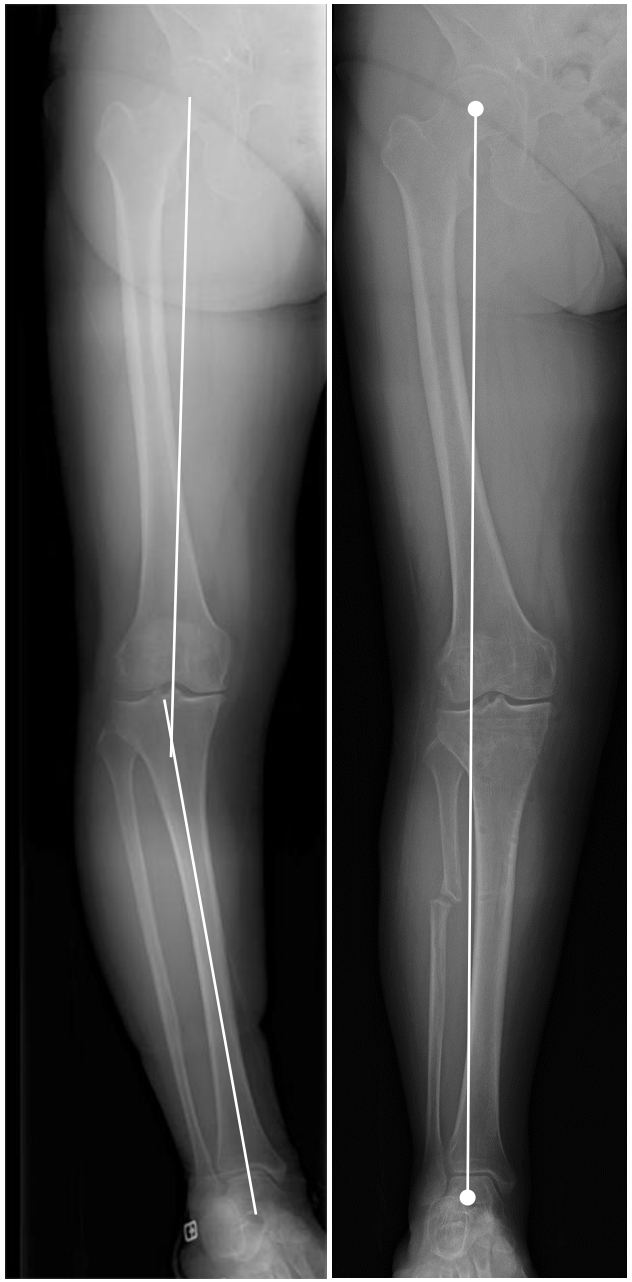


Discussion

- The improvement of the congruency of PF joint after NWHTO possibly decreased the contact stress of the lateral surface of the PF joint.

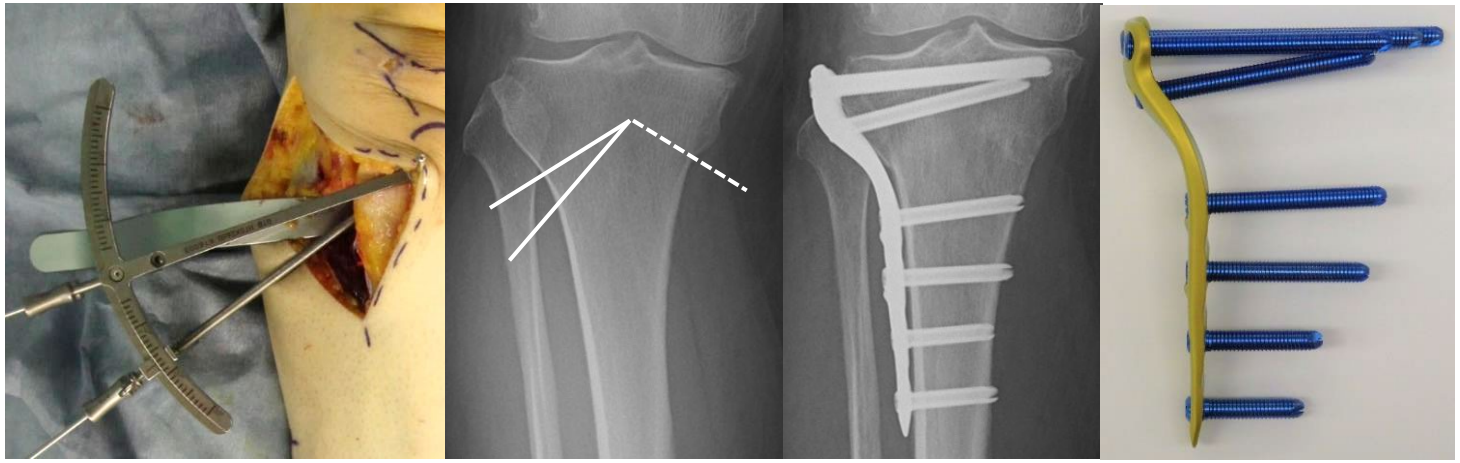
- NWHTO is an appropriate treatment for varus knee combined with PF OA.





Conclusion

- We investigated the stress distribution pattern on the PF joint after NWHTO.
- The tilting angle, lateral shift ratio, and TT-TG distance significantly decreased after NWHTO.
- NWHTO significantly decreased the stress distribution pattern on the lateral facet of patella.



Reference

[1] Kondo et al. Arthrosc Tech. 2018, [2] Kameda et al. Orthop J Sports Med. 2021