ISAKOS CONGRESS 2025 | MUNICH GERMANY June 8–11

Support instruments provide remarkable stability in medial closed wedge distal femoral osteotomy -A finite element analysis-

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Faculty Disclosure Information

- Nothing to disclosure

Background

Medial closed wedge distal femoral osteotomy (MCWDFO)

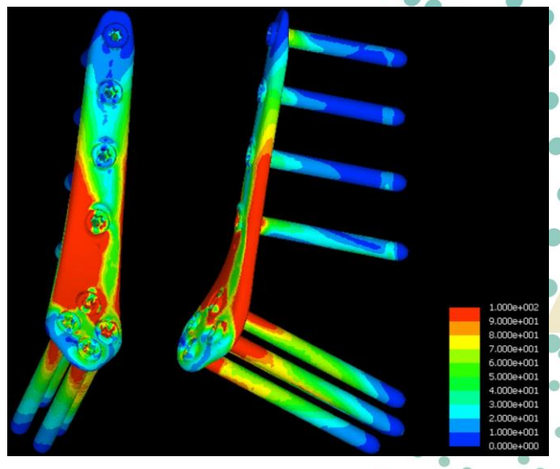
- ✓ Lateral hinge fractures during this procedure increase the risk of nonunion and loss of correction
- ✓ Support plates or screws are recommended when hinge fractures occur
- ✓ Few studies have evaluated the mechanical impact of hinge fractures in MCWDFO

Objectives

- ✓ To evaluate the influence of hinge fracture and support instruments on MCWDFO using finite element analysis

Hypothesis

- ✓ The support instruments contribute to the stability of the osteotomy site if a hinge fracture occurs



Materials and Methods

✓ Simulation models

➢ **Five** femur models using Mechanical Finder 11.0 FEA software (Research Centre of Computational Mechanics Inc.) from CT data of five OA knees

n = 5	Mean ± SD (range)
Age (years)	60 ± 7.4 (52–72)
Sex (Male / Female)	3 / 2
Body mass index (kg/m^2)	24.3 ± 2.9 (20.5–27.5)
mLDFA	87.6 ± 1.3 (86.3–89.7)

MLP, support plate / screw	
Young's modulus (GPa)	108.9
Poisson's ratio	0.28
Tension stress (MPa)	899.3
Compressive stress (MPa)	824.7
Density (g/cm^3)	4.43

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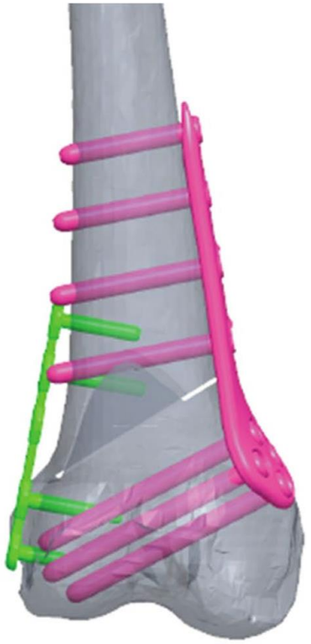
Materials and Methods

✓ Osteotomy simulation

Group A
Medial locking plate
(MLP; 5.5 mm screws)

Group B
MLP with a lateral support
4.5mm screw



Group C
MLP with a lateral support
plate / 4.2mm screws

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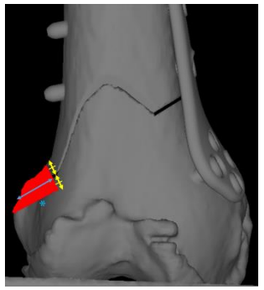
Materials and Methods

✓ Measurements

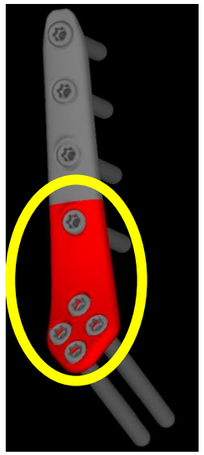
I



Percentage of CSR exceeding 100% (**hinge fracture; -**)

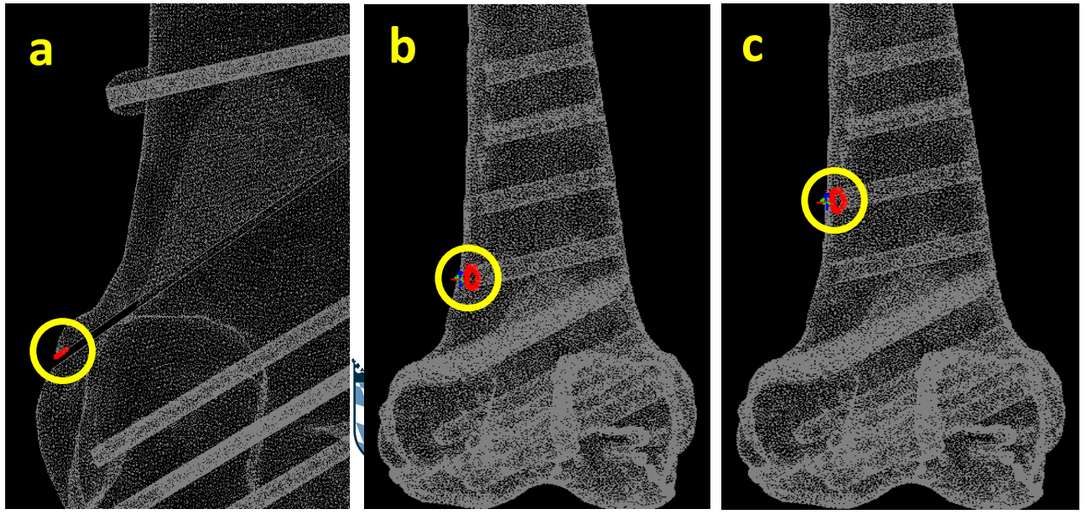
CSR: compression strength ratio

II



Equivalent stress of MLP (**hinge fracture; +**)

III



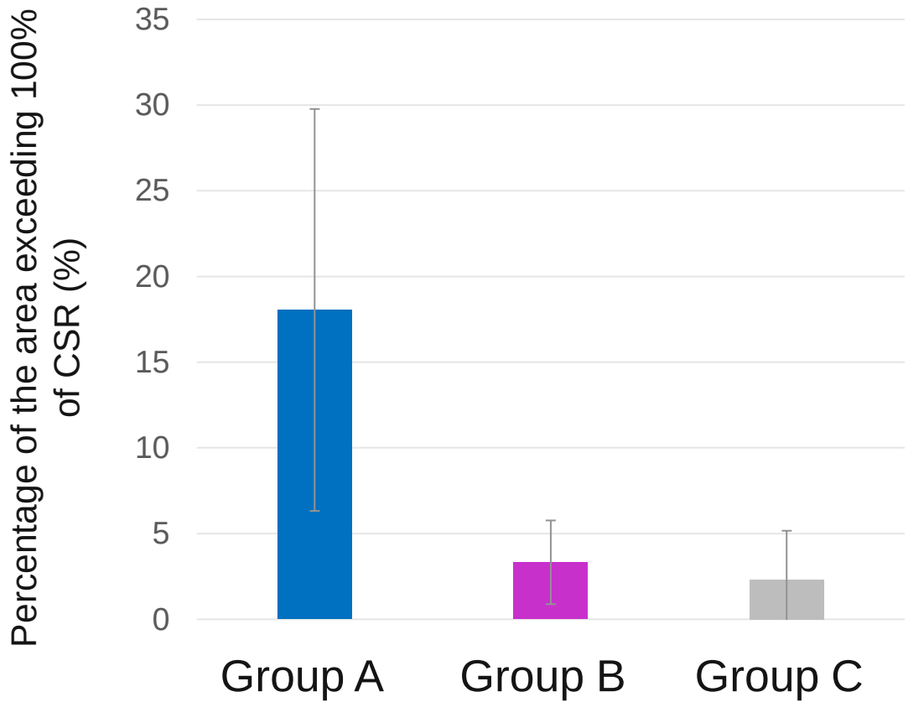
Degree of displacement of the hinge and screw holes (**hinge fracture; +**)

- **a**: fractured hinge area
- **b**: lateral screw hole at proximal first screw (hole 1)
- **c**: lateral screw hole at proximal second screw (hole 2)

Results

✓ Percentage of CSR exceeding 100%

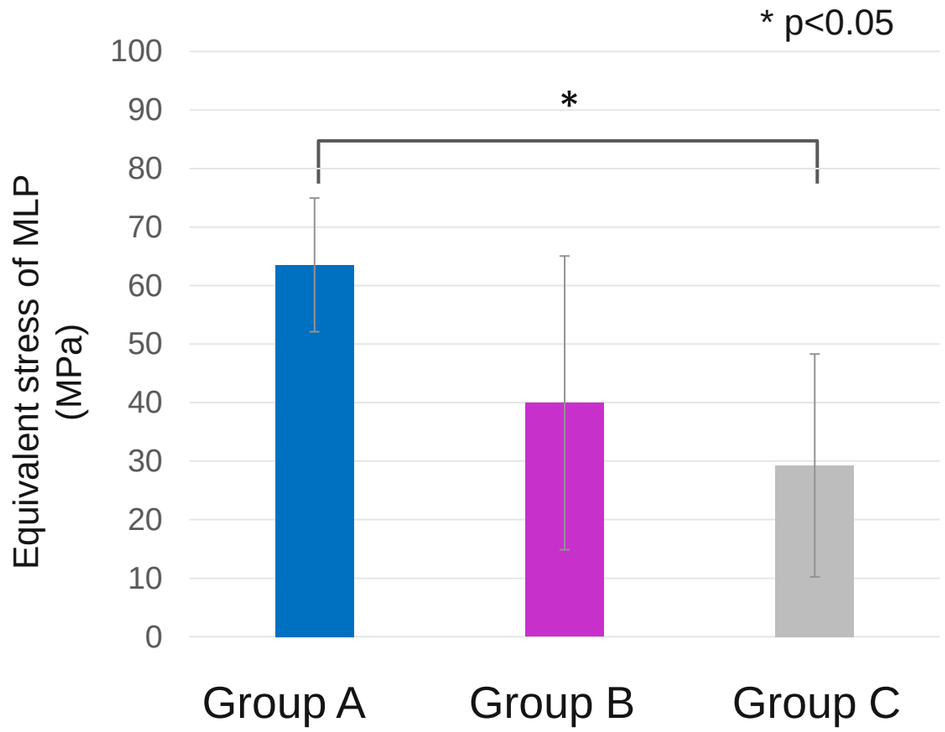
(**hinge fracture; -**)



➢ Percentages tended to be lower in groups B and C than in group A ($p > 0.05$)

Results

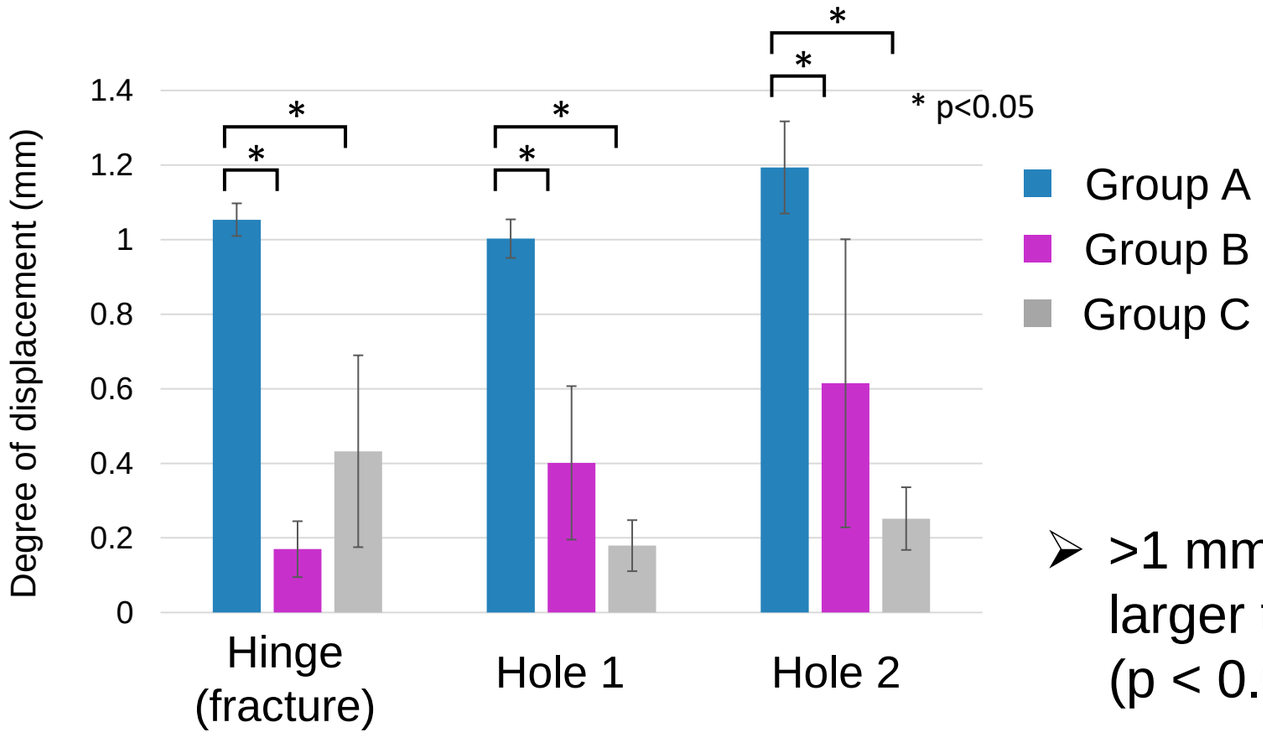
✓ Equivalent stress of MLP (**hinge fracture; +**)



➢ Mean equivalent stress of the MLP in group C was significantly lower than that in group A ($p < 0.05$)

Results

✓ Displacement of the hinge and screw holes (**hinge fracture; +**)



- >1 mm of displacement in group A, larger than groups B and C ($p < 0.05$)
- N.S. difference between groups B and C ($p > 0.05$)

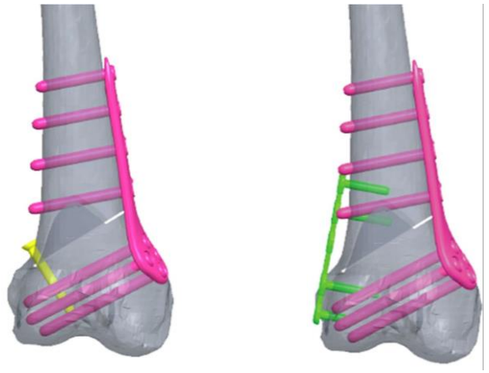
Discussion

- ✓ Fracture gap of < 2 mm and a motion amplitude of < 0.2 - 1 mm are desirable conditions for fracture healing *Jagodzinski M, Injury, 2007*

- ✓ Cadaveric study: A short support plate significantly reduced the translation and rotation of the fractured hinge and reduced the surface strain of the MLP in MCWDFO

  Matsushia T, Clin Biomech, 2022

- ✓ Present study: the support instruments, both the plate and screw, reduced the displacement to less than 1 mm and the equivalent stress of the MLP in the hinge fracture model



Conclusion

- ✓ In both plates and screws, the support instruments provided stability to the hinge site and reduced the equivalent stress of the main plate in the MCWDFO with hinge fractures

- ✓ The support plate tended to show greater stability than the screw, although there was no significant difference between the two instruments