



A Novel Locking Plate System with Cannulated Screws for Medial Opening Wedge High Tibial Osteotomy: Clinical and Radiological Comparisons with a Conventional Locking Plate

Eiji Kondo<sup>1</sup>, Koji Yabuuchi<sup>2</sup>, Koji Iwasaki<sup>3</sup>, Masatake Matsuoka<sup>3</sup>, Tomohiro Onodera<sup>3</sup>, Tomonori Yagi<sup>2</sup>, Kazunori Yasuda<sup>2</sup>, Norimasa Iwasaki<sup>3</sup>

<sup>1</sup>Centre for Sports Medicine, Hokkaido University Hospital, Sapporo, Japan <sup>2</sup>Department of Orthopaedic Surgery, Yagi Orthopaedic Hospital, Sapporo, Japan <sup>3</sup> Department of Orthopaedic Surgery, Faculty of Medicine and Graduate School of Medicine,Hokkaido University, Sapporo, Japan

## Eiji Kondo, MD, PhD

Centre for Sports Medicine,

Hokkaido University Hospital have the following financial relationships to disclose.

Grant/Research funding from Smith and Nephew, Japan Olympus Terumo Biomaterials, Japan





- Medial open-wedge (OW) HTO with a locking plate
  - $\checkmark$  Attracted a great deal of attention

Staubli et al Injury 2003, Lobenhoffer et al KSSTA 2003 Takeuchi et al Arthroscopy 2009

 $\checkmark$  Good short and mid-term clinical outcomes

Onodera et al KSSTA 2014, Kondo et al Am J Sports Med 2021 Niemeyer et al Arthroscopy 2010, Jung et al Arthroscopy 2013





- Complications
  - ✓ Pseudoarthrosis, hematoma, Infection, fracture, lateral hinge fractures, implant failure, etc

Valkering et al J Knee Surg 2009, Niemeyer et al Arthroscopy 2010, Takeuchi et al Arthroscopy 2012, Yabuuchi et al OJSM 2021





- Development of an original locking plate for OW-HTO
  - ✓ An anatomically shaped titanium alloy plate and cannulated locking screws
  - $\checkmark$  This plate can be located just on the medial side of the proximal tibia



![](_page_4_Picture_5.jpeg)

## • Purpose

 $\checkmark$  To compare clinical and radiological results of TriS and TomoFix plates in OWHTO.

![](_page_4_Picture_8.jpeg)

## Methods

5

Study design

- Retrospective comparative study
- OW-HTO: 205 patients, 225 knees (2011-2018)
  - ✓ Inclusion criteria
    - Medial OA or SONK
  - ✓ Sex: Women 147 patients 162 knees, Men 58 patients 63 knee
  - ✓ Age: 61 (36-84) years
- Group
  - ✓ TomoFix plate (Group F): 129 patients, 139 knees (2011-2014)
  - ✓ TriS plate (Group S): 76 patients, 86 knees (2015-2018)
- Clinical and radiological evaluations @ 3 years after surgery
- Statistics
  - ✓ Mann-Whitney U test, paired Student t test
  - ✓ Significant level was set at p=0.05

![](_page_5_Picture_16.jpeg)

![](_page_5_Picture_17.jpeg)

• Background characteristics of the patients

Group F (TomoFix)	Group S (TriS)	p-value
59.3 (9.3)	61.8 (8.2)	NS
40/93	29/47	NS
157.0 (7.9)	158.7 (9.4)	NS
63.4 (10.0)	66.5 (13.9)	NS
25.1 (3.5)	26.1 (4.2)	NS
92.0 (14.5)	90.4 (13.6)	NS
	Group F (TomoFix)   59.3 (9.3)   40/93   157.0 (7.9)   63.4 (10.0)   25.1 (3.5)   92.0 (14.5)	Group F (TomoFix)Group S (TriS)59.3 (9.3)61.8 (8.2)40/9329/47157.0 (7.9)158.7 (9.4)63.4 (10.0)66.5 (13.9)25.1 (3.5)26.1 (4.2)92.0 (14.5)90.4 (13.6)

Mean (SD)

![](_page_6_Picture_4.jpeg)

• Comparisons of preoperative status of the patients

	Group F (TomoFix)	Group S (TriS)	p value
Ext. angle ( $^{\circ}$ )	-2.5 (4.2)	-2.3 (4.2)	NS
Flex. angle ( $^{\circ}$ )	138.6 (9.1)	138.5 (9.8)	NS
JOA score <sup>a</sup> (points)	68.0 (12.4)	67.7 (14.0)	NS
FTA ( $^{\circ}$ )	179.5 (2.8)	180.3 (2.9)	NS
Mechanical axis (%)	26.5 (11.7)	22.7 (13.3)	NS
MPTA ( $^{\circ}$ )	85.2 (2.2)	84.7 (2.2)	NS
Tibial slope ( $^{\circ}$ )	8.8 (3.2)	9.0 (2.9)	NS
Insall-Salvati ratio (%)	1.1 (0.172)	1.0 (0.2)	NS
Caton-Deshamps index	0.9 (0.1)	0.9 (0.1)	NS
<sup>a</sup> Japan Orthopaedic AssociationSco	<i>e</i>		Mean (SD)

·Μ

Mean (SD)

![](_page_7_Picture_5.jpeg)

• Comparison of postoperative alignment immediately after surgery

	Group F (TomoFix)	Group S (TriS)	p value
Opening angle ( $^{\circ}$ )	11.6 (1.9)	10.6 (2.6)	NS
Opening distance between the osteotomy sites (mm)	11.9 (2.0)	10.6 (2.8)	NS
FTA (°)	169.7 (2.3)	169.3 (2.1)	NS
Mechanical axis (%)	69.1 (9.4)	66.4 (8.7)	NS
MPTA ( $^{\circ}$ )	94.0 (2.3)	93.7 (2.1)	NS
Posterior tibial slope ( $^{\circ}$ )	10.5 (3.6)	9.1 (2.6)	0.0035
Insall-Salvati ratio (%)	0.97 (0.14)	0.95 (0.14)	NS

Mean (SD)

![](_page_8_Picture_4.jpeg)

8

## • Radiological evaluations: CT

	Group F (TomoFix)	Group S (TriS)	p value	
The distance between plate and tibia (mm)	6.9 (1.7)	5.4 (1.2)	0.0157	
Plate position (%)	18.6 (13.7)	29.7 (9.5)	< 0.0001	
Screw angle ( $^{\circ}$ )	25.2 (10.5)	15.3 (6.6)	< 0.0001	
The distance to the popliteal artery (mm)	14.5 (7.8)	21.2 (6.7)	< 0.0001	Mean (SD)

![](_page_9_Figure_4.jpeg)

![](_page_9_Picture_5.jpeg)

CENTRE FOR SPORTS MEDICINE

• Comparison of postoperative alignment at final follow-up periods after surgery

	Group F (TomoFix)	Group S (TriS)	p value
FTA (°)	169.9 (2.3)	169.8 (2.2)	NS
Mechanical axis (%)	67.3 (9.7)	66.9 (8.8)	NS
MPTA ( $^{\circ}$ )	94.0 (2.4)	93.2 (2.1)	NS
Posterior tibial slope ( $^{\circ}$ )	10.7 (3.2)	9.2 (2.7)	0.0021
Insall-Salvati ratio (%)	0.98 (0.16)	0.95 (0.16)	NS
Caton-Deshamps index	0.79 (0.11)	0.80 (0.13)	NS
			Mean (SD)

![](_page_10_Picture_3.jpeg)

• The main findings of the present study were that, first, there was a significant difference in the plate position between Groups S and F.

 $\checkmark$  The TriS plate was fixed posteriorly at proximal tibia.

- Second, the screw angle was significantly lower in Group S than in Group F.
- Third, the distance from the screw to the popliteal artery was significantly shorter in Group F than in Group S.
- Frequency of symptoms due to skin irritation caused by the plate prominence was significantly less after HTO with the TriS plate than after HTO with the TomoFix plate, although there was no difference in the overall clinical and radiological results, and complications after OWHTO between the used 2 locking plates.

![](_page_11_Picture_6.jpeg)

- In both plate systems, the medial knee pain had resolved in all cases.
- In the plate positon, the TriS plate was fixed posteriorly at the proximal tibia.
- The TriS screw was also inserted more parallel to posterior cortex of the tibia.
  - ✓ The mechanical axis usually passes through the posterior aspect of the proximal tibia.
  - ✓ Therefore, previous studies reported that an application of the plate in a more posterior position provides greater stability

Martinez de Albornoz P et al KSSTA 2014

- The position of the proximal screw affects not only the stability of the osteotomy site but also the safety during surgery.
- The use of TriS plate system is thus likely to improve the initial axial and possibly rotational stability at the osteotomy site.

![](_page_12_Picture_9.jpeg)

- 1. Staubli et al Injury 2003
- 2. Lobenhoffer et al KSSTA 2003
- 3. Takeuchi et al Arthroscopy 2009
- 4. Niemeyer et al Arthroscopy 2010
- 5. Jung et al Arthroscopy 2013
- 6. Onodera et al KSSTA 2014
- 7. Kondo et al Am J Sports Med 2021
- 8. Valkering et al J Knee Surg 2009
- 9. Niemeyer et al Arthroscopy 2010
- 10. Takeuchi et al Arthroscopy 2012
- 11. Yabuuchi et al OJSM 2021
- 12. Martinez de Albornoz P et al KSSTA 2014

![](_page_13_Picture_13.jpeg)