ISAKOS CONGRESS 2023

Boston
Massachusetts
June 18–June 21

Serial Assessment of Bone Healing After Medial Opening Wedge HTO Without Bone Graft

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We have no financial conflicts to disclose

Introduction

- Medial Opening Wedge High Tibial Osteotomy (MOWHTO)

  well-established treatment option

  for early and moderate uni-compartmental OA in varus-aligned knee

- Disadvantage

  delayed union, nonunion

  loss of correction

-To prevent disadvantages

1. Filling the osteotomy defect: autograft, allograft, synthetic materials
2. Stable fixation ; locking systems

   stability, elasticity (bone growth by mechanical stimulation)

Background

- Bone filling is not always necessary : opening gap size

	osteotomy gap size
El-Assal MA, KSSTA, 2010	< 14 mm
Galla and Lobenhoffer, Oper Orthop Trauma, 2004	<13 mm
Stuart M, Insall Scott Surg, Knee, 2012	<12 mm
Slevin O, KSSTA, 2016	< 10 mm

* There is no strong quality of evidence to establish clear guidelines

- After MOWHTO without bone graft ,

  serial monitoring of bone healing rate : poorly defined

  There are no prospective previous reports on the serial monitoring of bone healing

Purpose

After MOWHTO using a locking plate (TomoFix®) without bone graft,
on serial plain radiographs
(minimum 24 months f/u)

(1) To investigate the osteotomy bone healing (gap filling) rate

(2) To evaluate whether alignment correction could be maintained

Materials and Methods

- **Prospective Design**; (Oct. 2013 ~ Mar. 2016)
  patients who symptomatic medial OA with varus malalignment
  locking plate (TomoFix®) without bone graft

- **Exclusion**
  age > 65 years
  rheumatoid arthritis
  ROM < 100° and flexion contracture of >10°
  a minimum follow-up of < 24 months

- **Serial radiographs**
  preoperative, postoperatively, at 1,3,6,12,18,24 months after surgery

Radiologic evaluation

- Oblique view : bone healing (gap healing)

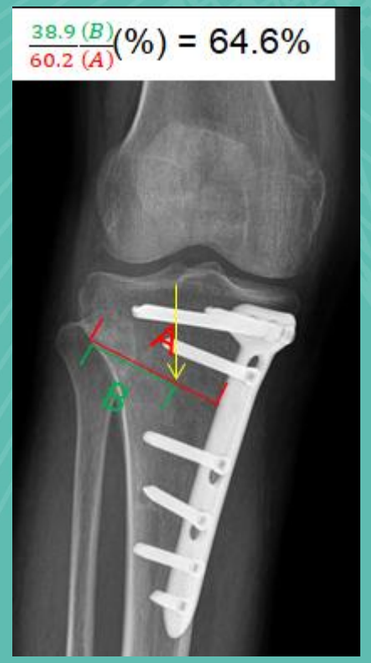
  * Modification of Staubli`s method : to avoid the exaggeration of bone healing

- Weight bearing long-standing AP view of the lower extremity :

  mechanical axis (MA) angle , weight bearing line (WBL) ratio

- Lateral view: posterior tibial slope angle (PTSA)

Staubli's method (AP view)



Our method (oblique view)

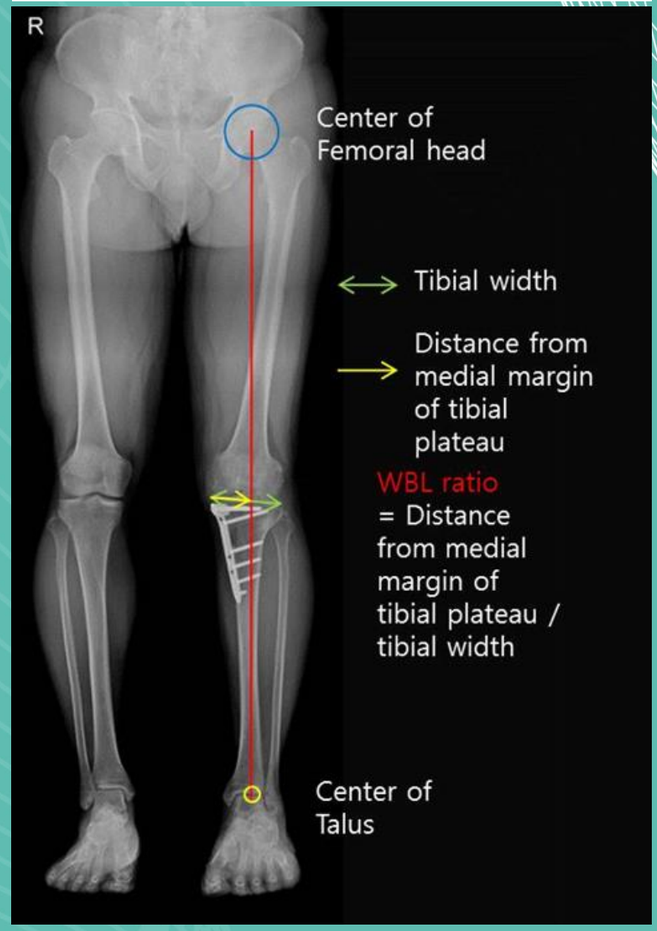
Measurement of gap filling
(Staubli's method)
on AP view

B/A x100 (%)

(A) Length of the osteotomy from medial to lateral
(B) The part of osteotomy that is not visible

MA angle

WBL ratio



Posterior slope (Giffin method)

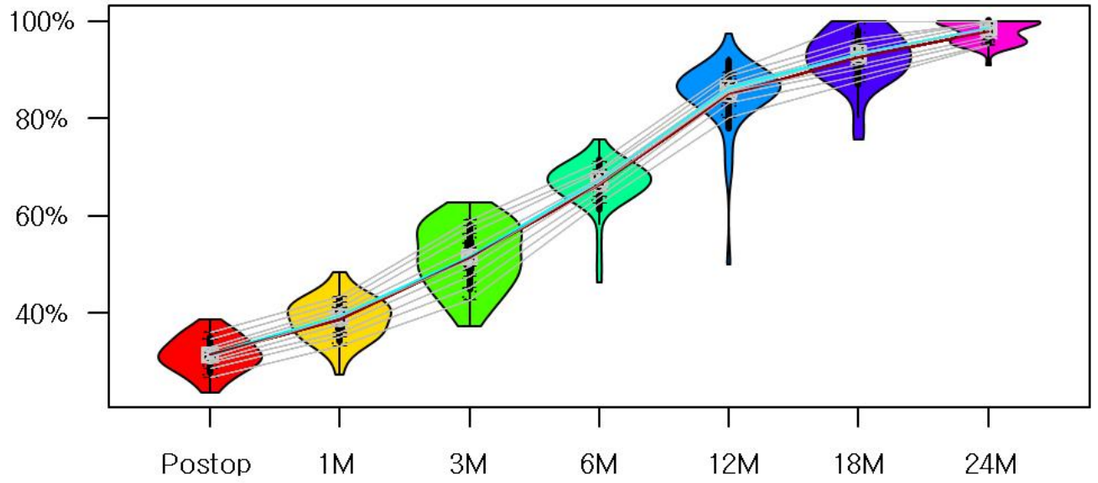
Results

Demographic data

Variable	Data (n=49)
Sex (male/female), n	19/30
Site (right/left),n	27/22
Age, year (Mean ± SD)	52.2 ± 6.4 (range,35-65)
BMI, kg/m^2 (Mean ± SD)	26.3 ± 3.7
Smoking,n	8
Lateral hinge fracture, n	4 (Type I: 2,Type III: 2)
Follow-up, month (Mean ± SD)	34.3 ±11.8 (range,24-60)
gap opening height, mm	10.2 ± 2.9 (range,7-20)

Bone healing rate 1

- 12 months : 84 ± 7 % (< 80 % bone healing in 5 of 49 knees)
- 24 months : at least 90 % in all knees
- re-operation (-) , no infection (-)



	Post-op	1 M	3M	6M	12M	18M	24M
Mean ± SD (%)	31±4	38±4	51±7	66±5	84±7	92±6	97±2

ICC=0.93

Results

Bone healing rate 2

- The correlation analysis (Pearson test, Linear regression)

  between bone healing rate and demographic variables

- age, sex, BMI, smoking, and hinge fracture

not significant associated with bone healing rate

- opening gap height

had significant related to bone healing rate after 6 months

6 months (P < 0.001)

12 months (P < 0.01)

18 months (P < 0.01)

24 months (P < 0.001)

Maintenance of correction

Weight-bearing line (WBL) ratio

	Pre-op	1 M	3M	6M	12M	18M	24M
Mean±SD (%)	22 ± 8	61 ± 6	60 ± 6	60 ± 6	60 ± 6	60 ± 6	59 ± 6

ICC=0.82

Mechanical Axis (MA) angle

	Pre-op	1 M	3M	6M	12M	18M	24M
Mean±SD (°)	- 6.1 ± 3.3	2.1 ± 1.2	2.0 ± 1.2	2.0 ± 1.1	1.9 ± 1.1	1.9 ± 1.1	1.9 ± 1.1

ICC=0.88

*** WBL ratio, MA angle**

Statistical differences between preoperatively and 1 month (P<0.001)

No statistical difference after 1 month

Posterior tibial slope angle (PTSA)

	Pre-op	Post-op	1 M	3M	6M	12M	18M	24M
Mean±SD (°)	9.6 ± 3.2	9.9±3.3	11.1±3.8	11.0 ±3.3	11.7±3.6	11.5±3.6	11.6±3.6	11.8±5.2

ICC=0.87

*** PTSA**

Statistical differences between 1 month and 3 months (P=0.02)

No statistical difference after 3 months

Summary

- A prospective, single center, single surgeon series; 49 cases

  MOWHTO with TomoFix without bone graft: minimum 24 months f/u

Bone healing rate

In all patients,

> 90 % spontaneous gap healing of the osteotomy site

(re-operation - , no infection -)

Correlation analysis

opening gap height : the only predictor for bone healing

WBL ratio, MA angle

no correction loss postoperatively

PTSA

increased from postoperatively (9.9°) to 1 month (11.1°) (P = 0.02)

no correction loss after 3 months postoperatively

The time of bone healing rate after MOWHTO

- Bone healing rate

	Post-op	1 M	3M	6M	12M	18M	24M
Mean ± SD (%)	31±4	38±4	51±7	66±5	84±7	92±6	97±2

- The definition of delayed union and malunion after MOWHTO?

variable

* In extremity fractures,

delayed union: 3 months, malunion: 6 months

* In our opinion,

the same definition in bone fractures are in sufficient in MOWHTO.

when considered re-operation for delayed union or non-union,

a critical assessment of both radiographic and clinical factors

(clinical factors: the lack of ability to bear weight, pain, tenderness)

Conclusion

- MOWHTO with use of TomoFix without bone graft

  spontaneous and nearly total gap healing of the osteotomy site is usually achieved

- As a part of the MOWHTO ,

  routine addition of bone graft might be unnecessary

  - To shorten the operative time
  - To avoid unnecessary morbidity
  - To reduce cost

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