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Digital Planning Using Medial Proximal Tibial Angle and 3D-Printed Patient-Specific Instrument in Medial Opening Wedge High Tibial Osteotomy Could Provide an Accurate and Reliable Correction for Medial Knee Osteoarthritis

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- No financial disclosure
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Background

- **Fujisawa** point is regarded as the golden standard for the correction target in varus knee while performing MOWHTO.
- We conducted **digital planning** and **3D printed patient-specific instruments (PSI)** in this study to minimize the manual error in surgery.
- We hypothesized that the postoperative **MPTA** of less than or equal to around **93°** would be the most ideal for MOWHTO, with factors such as clinical outcomes and overcorrection prevention considered.

Methods

- From Aug. 2018 to Jul. 2021, PSI-guided MOWHTOs were performed on a total of 35 patients and 36 knees.
- Inclusion criteria:
  - Mild to moderate medial compartment osteoarthritis (grade 1 to 3 on the Kellgren–Lawrence Classification)
  - Varus alignment of knee (MPTA < 85˚)
- Exclusion criteria
  - Ligamentous instability of knee
  - Severe multicompartmental arthritis
  - Osteonecrosis of proximal tibial

Preoperative Planning

- Preoperative measurements were labelled over the radiograph, such as WBL, MPTA, LDFA, and HKA.
- In the software (**OsteoMaster**), approximate **93˚ of MPTA** was set as the correction target.

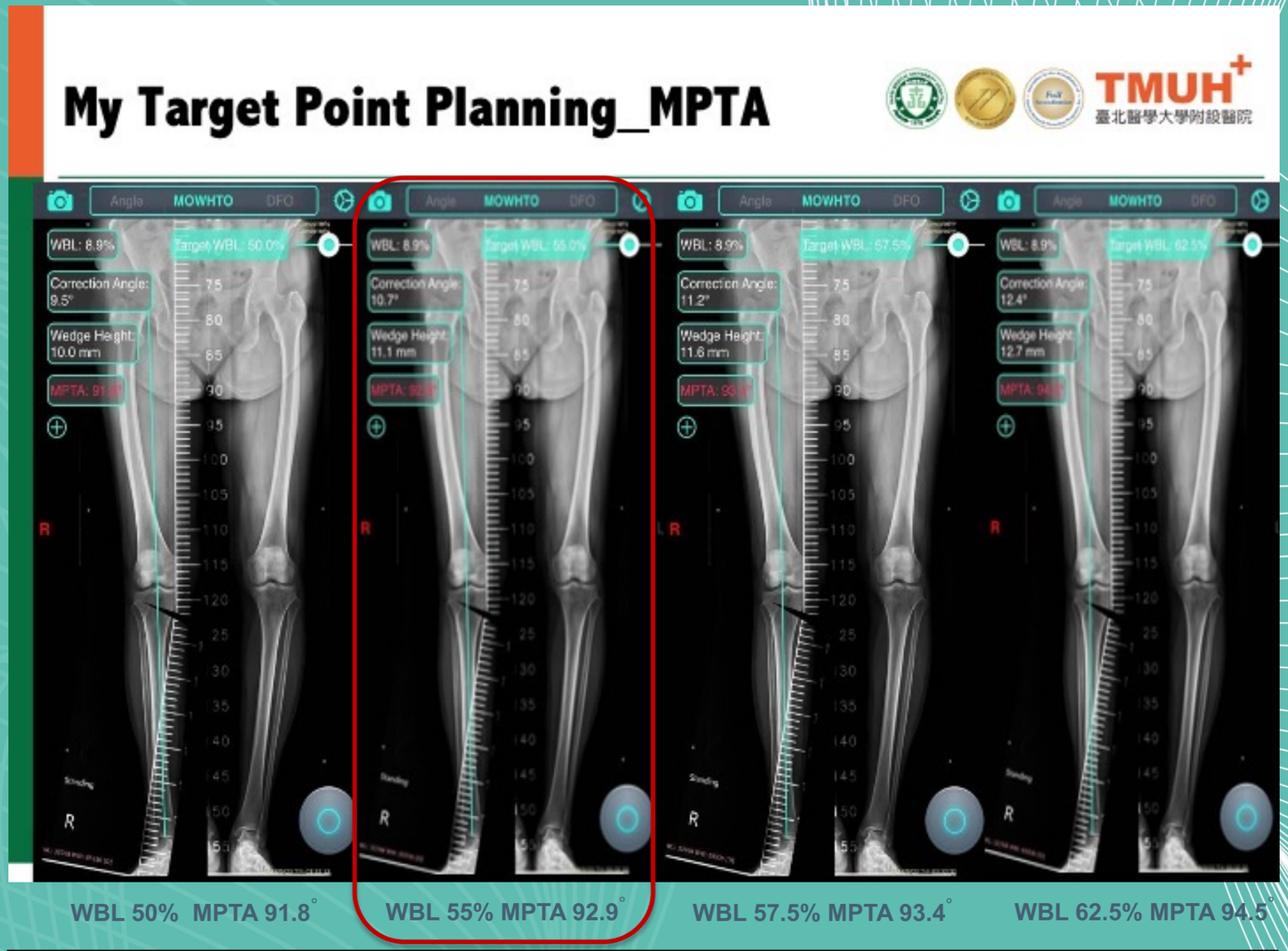

Figure: Simulated postoperative measurements of the patient's correction parameters using the preoperative planning software **OsteoMaster**

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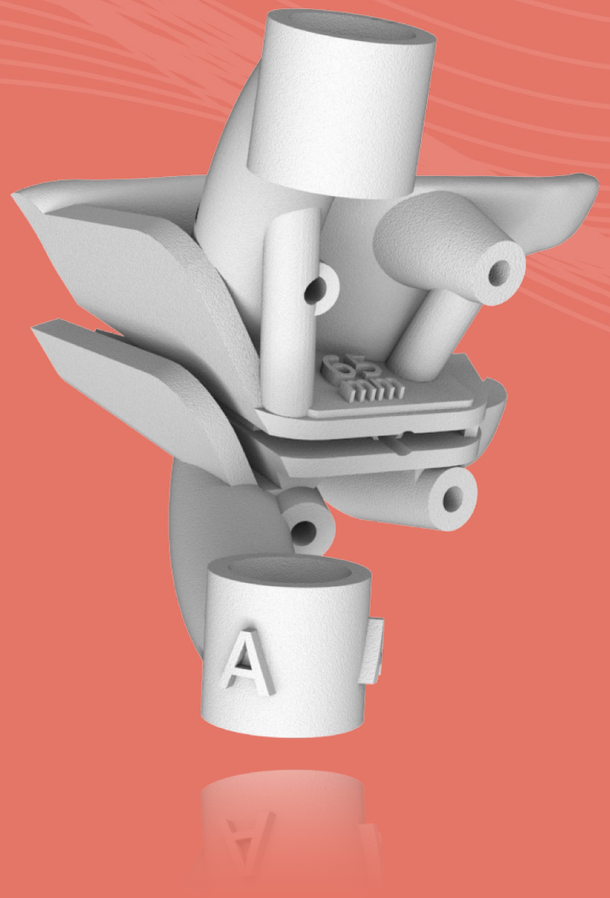
3D-printed PSI



The PSI was designed according to the combination of 2D planning and CT images of the relevant anatomical landmarks which consist of a cutting slot, guiding plane, two extended arms, and two alignment holes.

Approaches

- After approaching to the medial cortex of the tibial , the PSI-guide was attached and fixed to the bone. The edge of the cutting slot on the PSI guide was parallel to the lateral hinge. The sawing depth was calculated preoperatively and marked on the length scale of the saw blade.
- Osteotomy was then performed by moving a graduated oscillating saw along the cutting slot to create the desired hinge. The osteotomy was gently distracted with a series of osteotomes until it reached the preoperatively planned MPTA

Figure:3D-PSI guide during medial opening wedge high tibia osteotomy

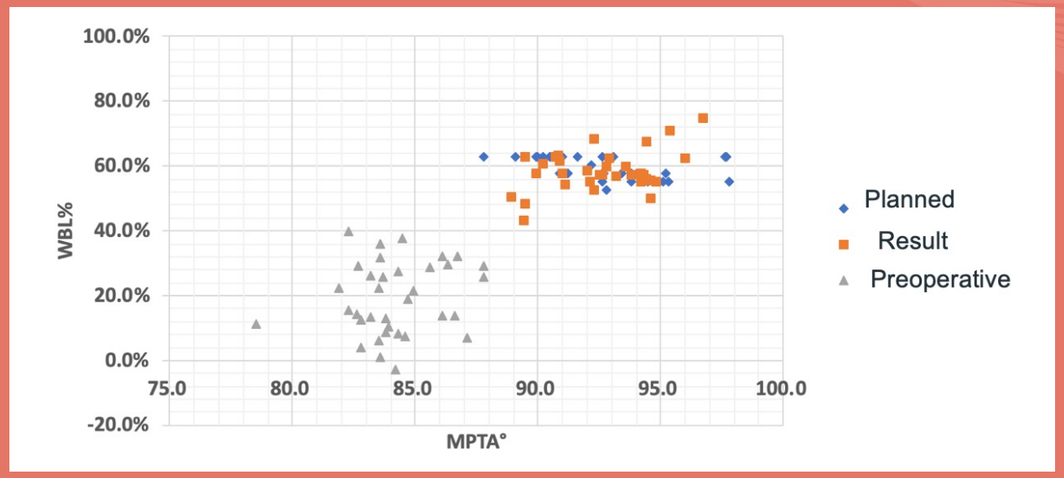
Clinical Results

- The mean postoperative MPTA and WBL was 92.5° ± 2.2° and 57.8% ± 6.6%.
- All varus malalignment cases had been corrected to a mean HKA of 2.3 ± 1.1°.
- No significant changes of posterior tibial slope were observed (P<0.05).
- The average KOOS of all patients was improved from 34% to 65% (P<0.05).

Outcomes	Values	
	Pre-operation	Post-operation
MPTA °	84.2 ± 1.9	92.6 ± 2.1
WBL %	19.1 ±11.2	58.3 ± 6.3
HKA °	-2.8 ± 2.0	2.3 ± 1.1
KOOS score %	34 ± 10	65 ± 6

Simulation Results

- When targeting at the Fujisawa point in all patients, the simulated results of postoperative MPTA show that 22 of 35 cases (63%) are greater than 93°, which may result in oblique joint line and valgus deformity.



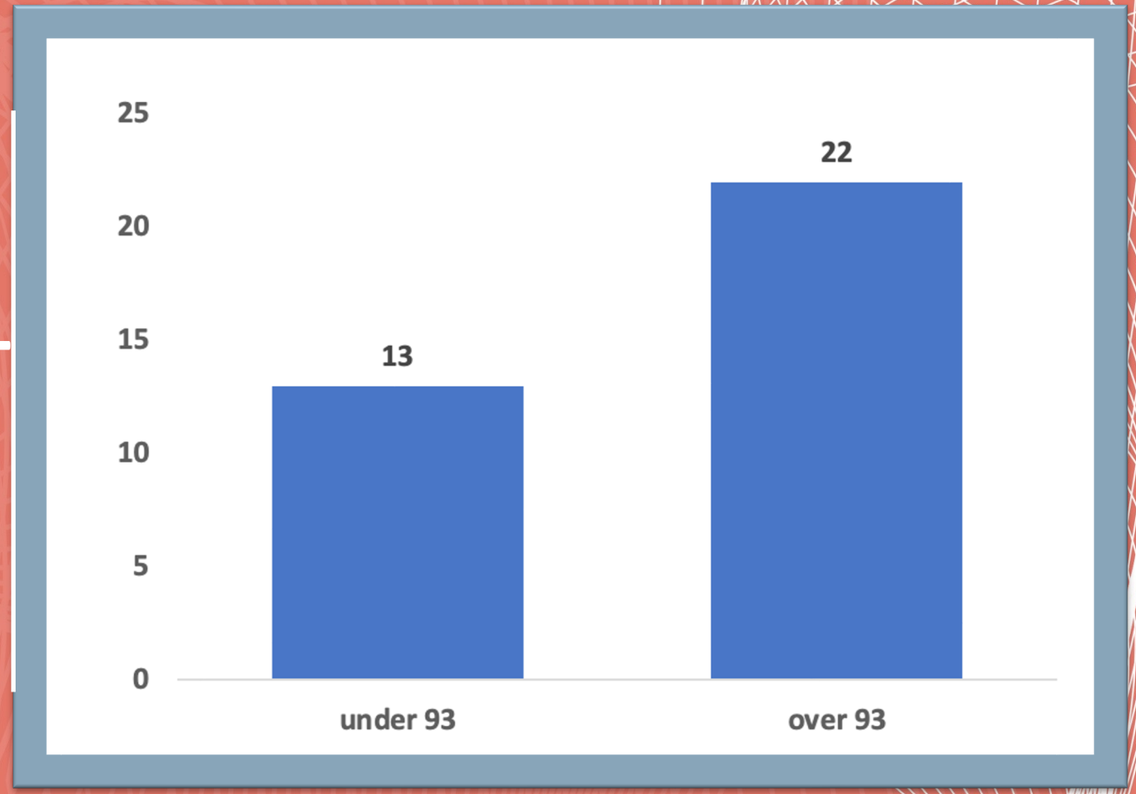


Figure: The amount of patients with MPTA > 93° when targeting at the Fujisawa point

Correction Error

- This technique leads to high accuracy outcomes around the target with **less than 1%** of MPTA and WBL error between preoperative planning and postoperative results.

Outcomes	Values			
	Pre-OP	Planning	Post-OP	Error
MPTA °	84.2 ± 1.9	92.9 ± 2.3	92.6 ± 2.1	-0.4 ± 1.9
WBL %	19.1 ± 11.2	58.9 ± 3.2	58.3 ± 6.3	-0.4 ± 6.0

Conclusion

- Targeting the MPTA at less than or equal to **93°** as the primary planning angle could achieve a more favorable outcome and avoid overcorrection.

- With the help of a **digital planning** software and **3D printed PSI**, the postoperative results could be accurately performed.

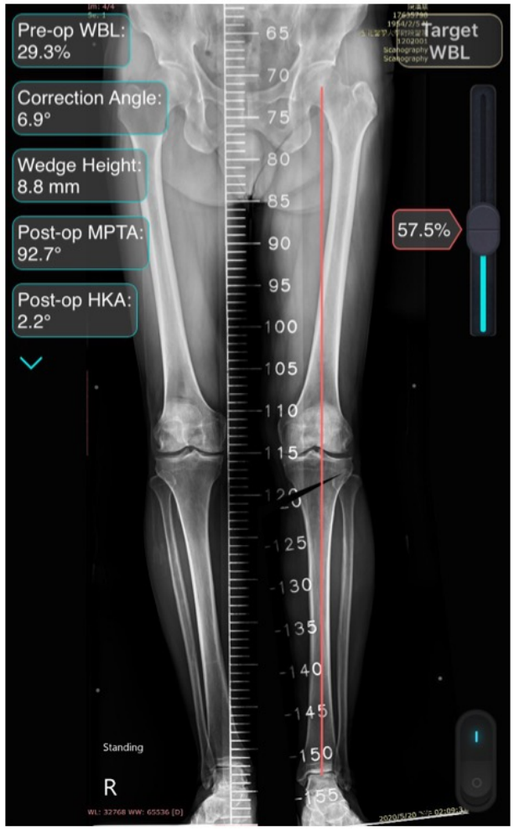
Case example

Pre-OP

WBL:29.5%

MPTA:86.3°

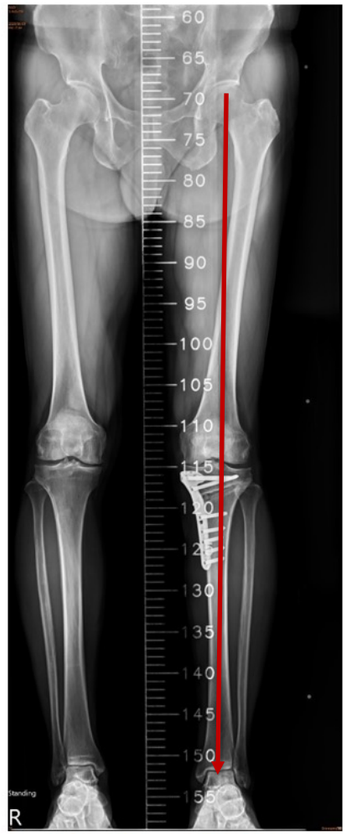
Planning



WBL:57.5%

MPTA:92.7°

Post-OP



WBL:57.8%

MPTA:93.4°

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