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Short-term Results and Learning Curve of TKA with Mako Robotic Arm

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Faculty Disclosure Information

- Nothing to disclosure for all author

Aims

In surgery, various tools have been developed to eliminate human error and ensure uniformity of procedures. Currently, TKA using a surgical robot is the latest tool.

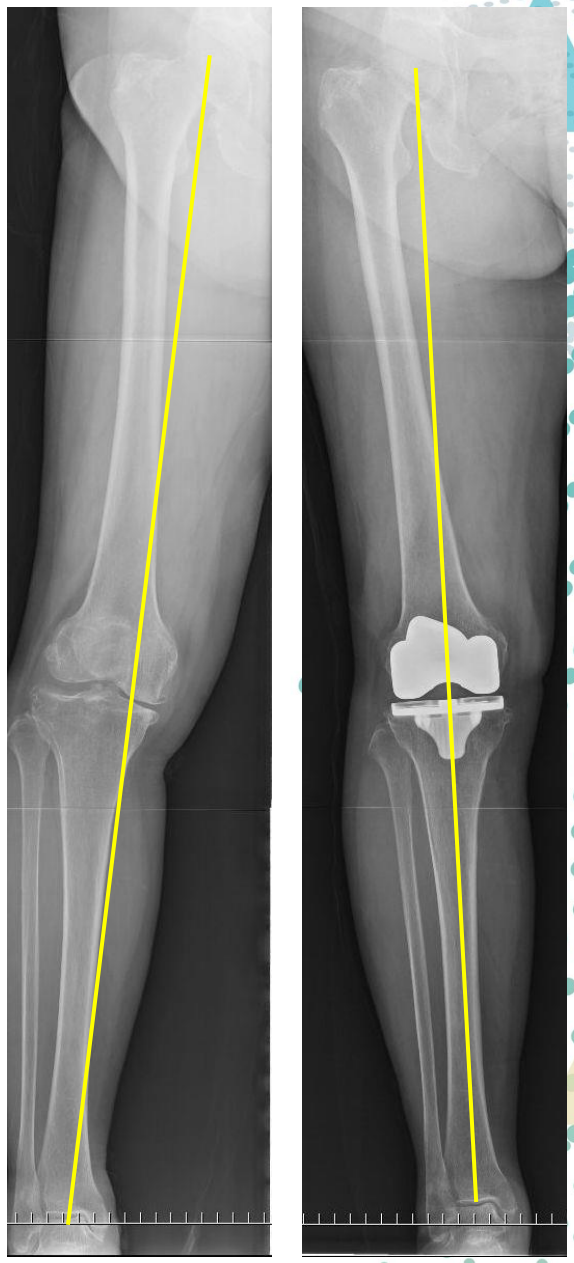
The application of robotics in the operating room for total knee arthroplasty (TKA) remains controversial.

The aim of this study was to investigate the short-term results and learning curve of robotic arm-assisted TKA performed by one certified prosthetic surgeon in Japan.

Material

Disease: Osteoarthritis of the knee
Approach : Trivector approach
Bone cut: Mechanical Alignment
Patella: non resurfaced

40 knees (7 males and 33 females)
observed for 3 months after performing CR type TKA with Mako robotic arm-assisted system.
Age: 76.6 ± 6.4 years
BMI: 25.3 ± 3.8



Methods

Research items

- ✓Range of motion
- ✓thigh circumference
- ✓learning curves for operative time (using CUSUM Analyses)

Evaluation Criteria

- ✓Pain Visual Analogue Scale (VAS)
- ✓Knee Injury and Osteoarthritis Outcome Score (KOOS)
- ✓MOS 36-Item Short-Form Health Survey (SF-36®)
- ✓Forgotten Joint Score-12 (FJS)

(check before surgery, at discharge and 3 months after surgery)

Analysis : Paired t-test

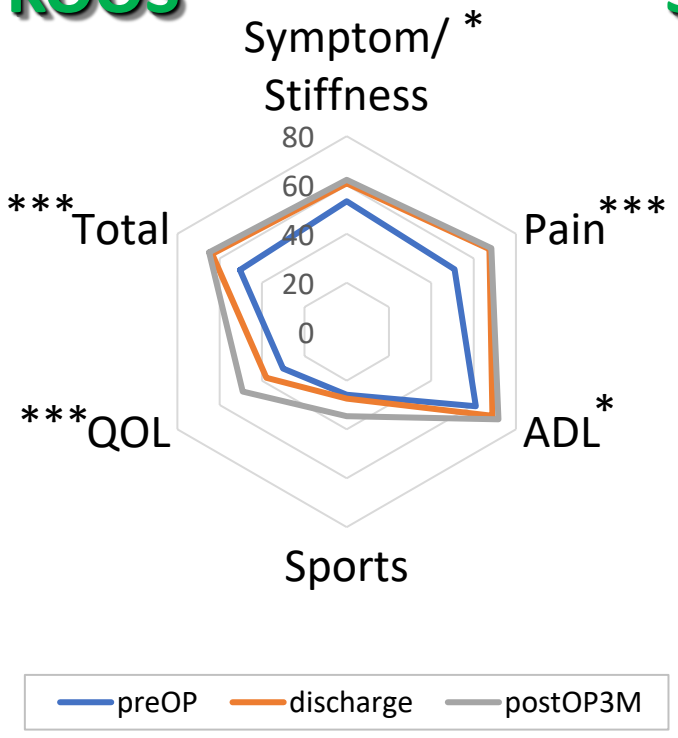
Results

	Pre OP	At discharge	Post OP(3M)
Extension	-10.1±6.1°	-4.3±4.7°***	-4.3±4.1°
Flexion	124.5±14.1°	124.1±6.1°	121.3±6.1°
Thigh Circumference	39.3±5.8cm	39.4±4.4cm	40.1±3.6cm
VAS	47.1±31.0pts	15.0±14.0pts***	12.7±17.8pts**
FJS	22.7±17.7pts	33.9±21.9pts**	38.1±21.3pts**

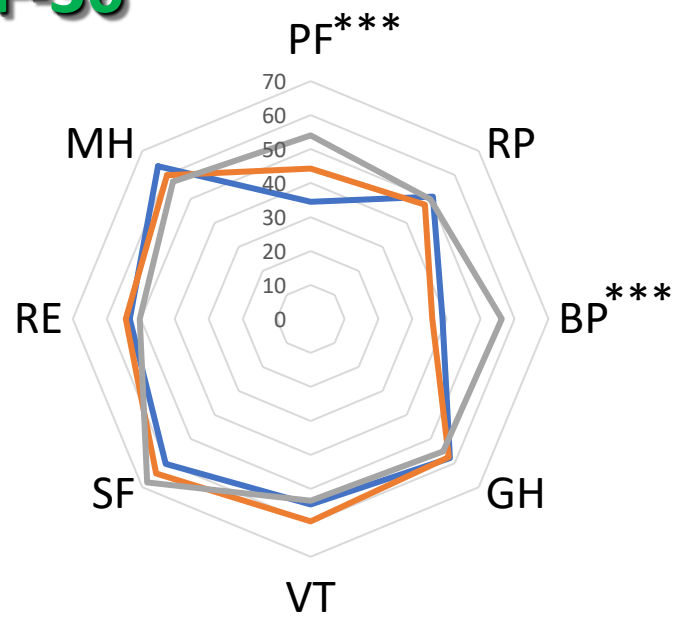
*P<0.05 **P<0.01 ***P<0.001

Results

KOOS



SF-36

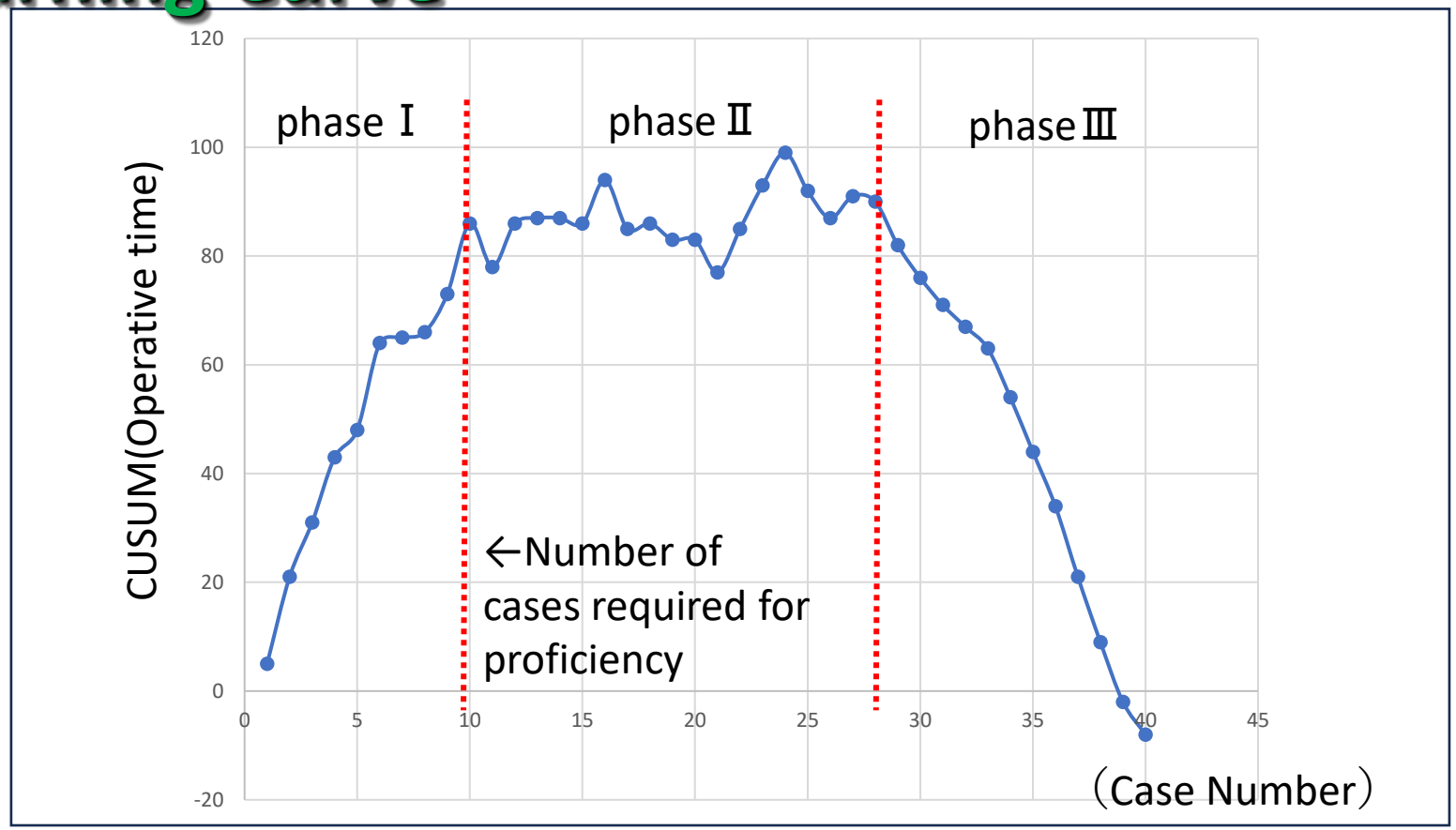


*P<0.05 **P<0.01 ***P<0.001

At discharge (average 17.5±5.9 days postoperatively), there was significant improvement in KOOS (Pain, ADL, Total), SF-36 (PF, MH).
At 3 months postoperatively, there was significant improvement in KOOS (Symptom/Stiffness, Pain, ADL, Quality of Life, Total), SF-36 (PF, BP).

Results

Learning Curve



Phase Ⅰ: Initial learning phase
Phase Ⅱ: Consolidation phase
Phase Ⅲ: Experience phase

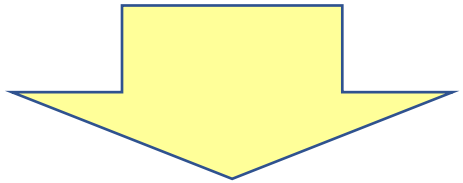
The operative time was average 49.8±8.0 minutes, with a median of 50 minutes; robotic arm-assisted TKA was associated with a learning curve of 10 cases for operative times ($p < 0.01$).

Discussion

Robot-assisted surgery provides several advantages in TKA including real time information in millimeters to help obtain balanced gaps, accurate bone cuts, reduced soft tissue injury, and achieve the target alignment which may lead to improved patient satisfaction[1)].

Stereotactic boundaries also confine bone resection to the limits of the haptic windows, which helps to reduce manual errors in bone resection and iatrogenic soft tissue injury from the handheld sawblade used in conventional TKA[2)].

There was no postoperative swelling, a decrease in pain VAS during exercise and significant improvement in FJS from early on.



✓ Significant pain relief was achieved early on, and this reduced awareness of the operated knee.

Discussion

Surgical time is prolonged compared to manual surgery, but there is some learning curve.

The most pertinent findings from this study are that robotic-arm assisted TKA was associated with a learning curve of seven cases for operative times and surgical team comfort levels[3)] .

Robot-assisted TKA was associated with a learning curve of 11-43 cases for operative time. This learning curve was significantly affected by the surgical profile[4)] .

Koenig et al. retrospectively reviewed the first 100 Robot-assisted TKA at their institution and demonstrated that within 20 cases they were able to achieve operative times within 5 minutes of manual TKA[5)].

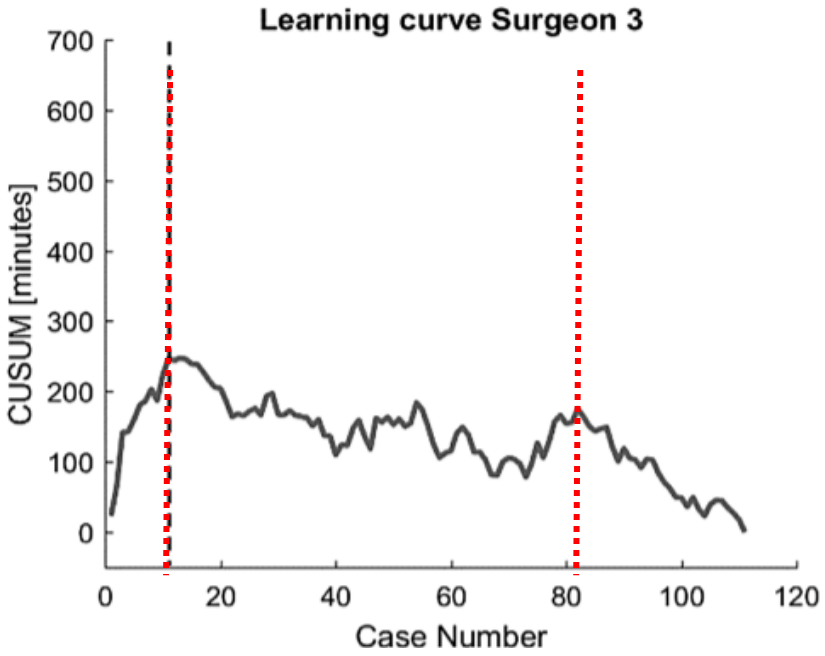
Discussion

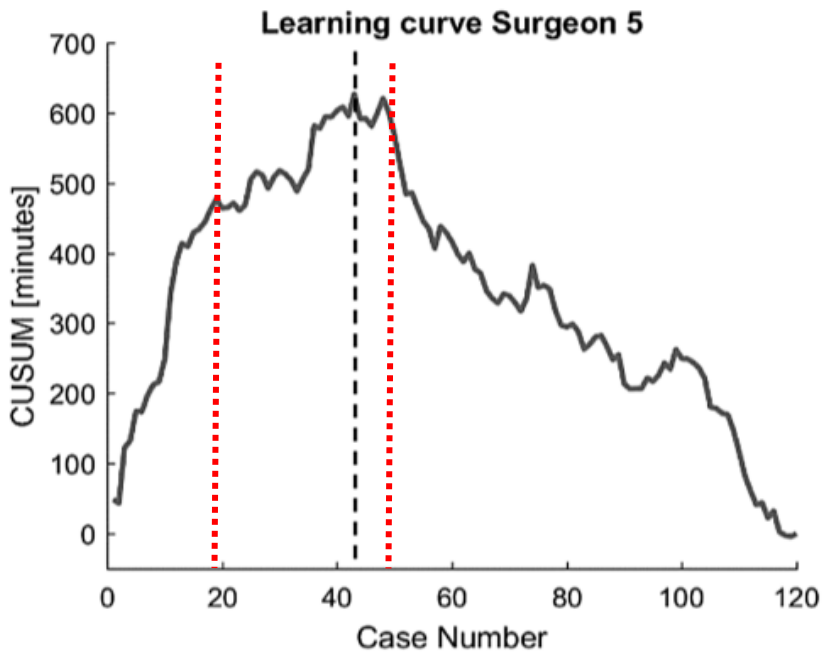
Vermue et al. examined the learning curves of several surgeons at various surgical levels and found that 10 to 40 cases were needed[4] .However, the way they read the graph was different from ours, and it was clear that a high-volume surgeon who performs more than 100 manual TKA cases per year can become proficient in 10 to 20 cases.

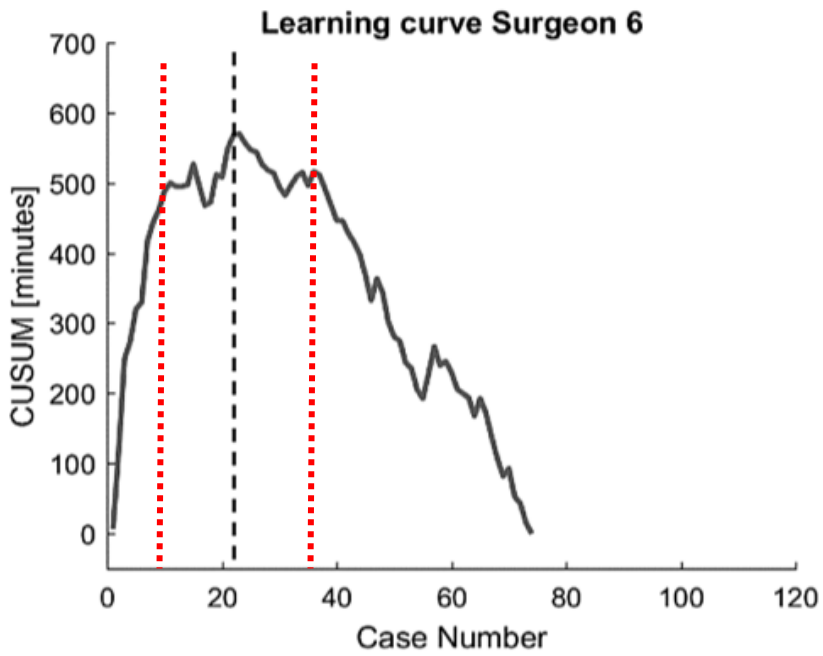
Table 1 Surgeon characteristics

Surgeon	Years in practice	Case volume
Surgeon 1	11	Medium
Surgeon 2	28	Low
Surgeon 3	32	High
Surgeon 4	25	Low
Surgeon 5	5	High
Surgeon 6	5	High

Case volume is defined as either low (< 50 cases/year), medium (50–100 cases/year) and high (> 100 cases/year)







Conclusion

- We discussed the short-term results and learning curve of Mako robotic arm-assisted surgical TKA.
- The use of the robotic arm significantly improved pain early on and also reduced awareness of the knee joint.
- Although the Mako robotic surgery took longer than manual surgery, the learning curve was about 10 cases, and better results were obtained in the early time.

Reference

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