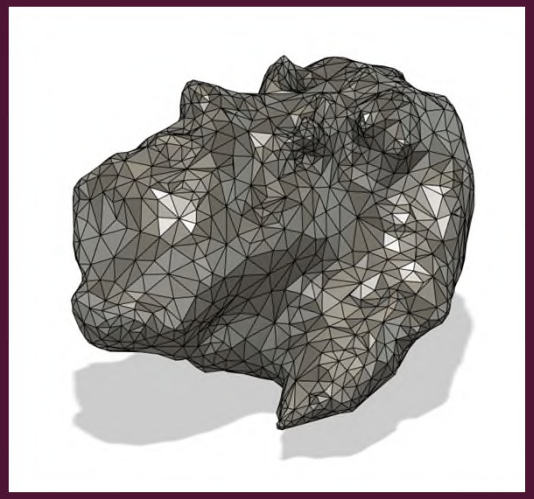
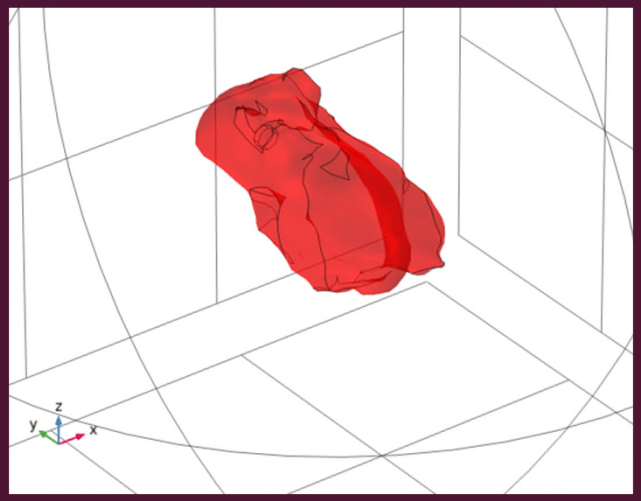
# COMPARISON BETWEEN SUPRAORBITAL KEYHOLE AND KOCHER'S POINT APPROACH AS AN OPTIMAL TRAJECTORY FOR STEREOTACTIC HEMATOMA ASPIRATION OF BASAL GANGLIA HEMORRHAGE: CLINICAL ANALYSIS AND COMPUTATIONAL SIMULATIONS

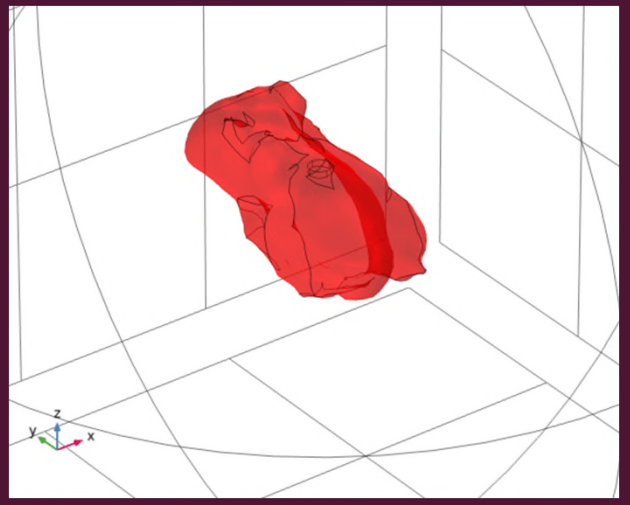
PRESENTER : **JANG HUN KIM** [1]

AUTHORS : KYUNGWON PARK [2], JOO WON KANG [3], KYUNG-JAE PARK [1], SEOK JUNG [2]

AFFILIATIONS : KOREA UNIVERSITY ANAM HOSPITAL[1], KOREA UNIVERSITY[2], UNIVERSITY OF ILLINOIS CHICAGO[3]

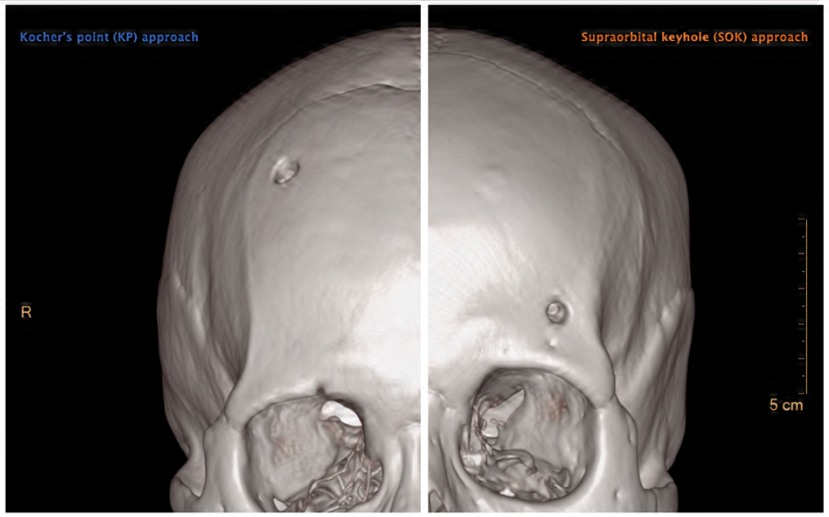




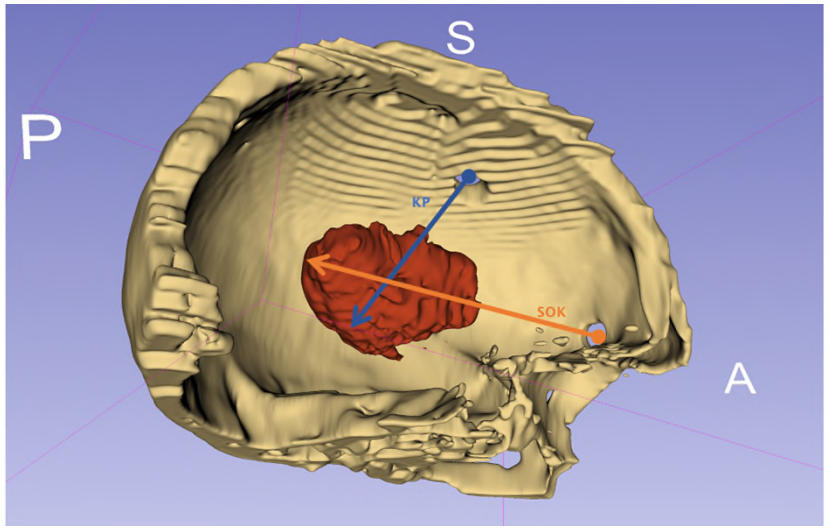
# BACKGROUNDS

- **Intracerebral hemorrhage**: m/c in hemorrhagic stroke
- **Basal ganglia** ICH: m/c location in hypertensive ICH
  - Deep brain location: minimally invasive surgery is widely perforr
  - Ideally, long axis catheter trajectory is necessary.
  - Anatomically, AP (Anterior-posterior) diameter > SI (superior-infe



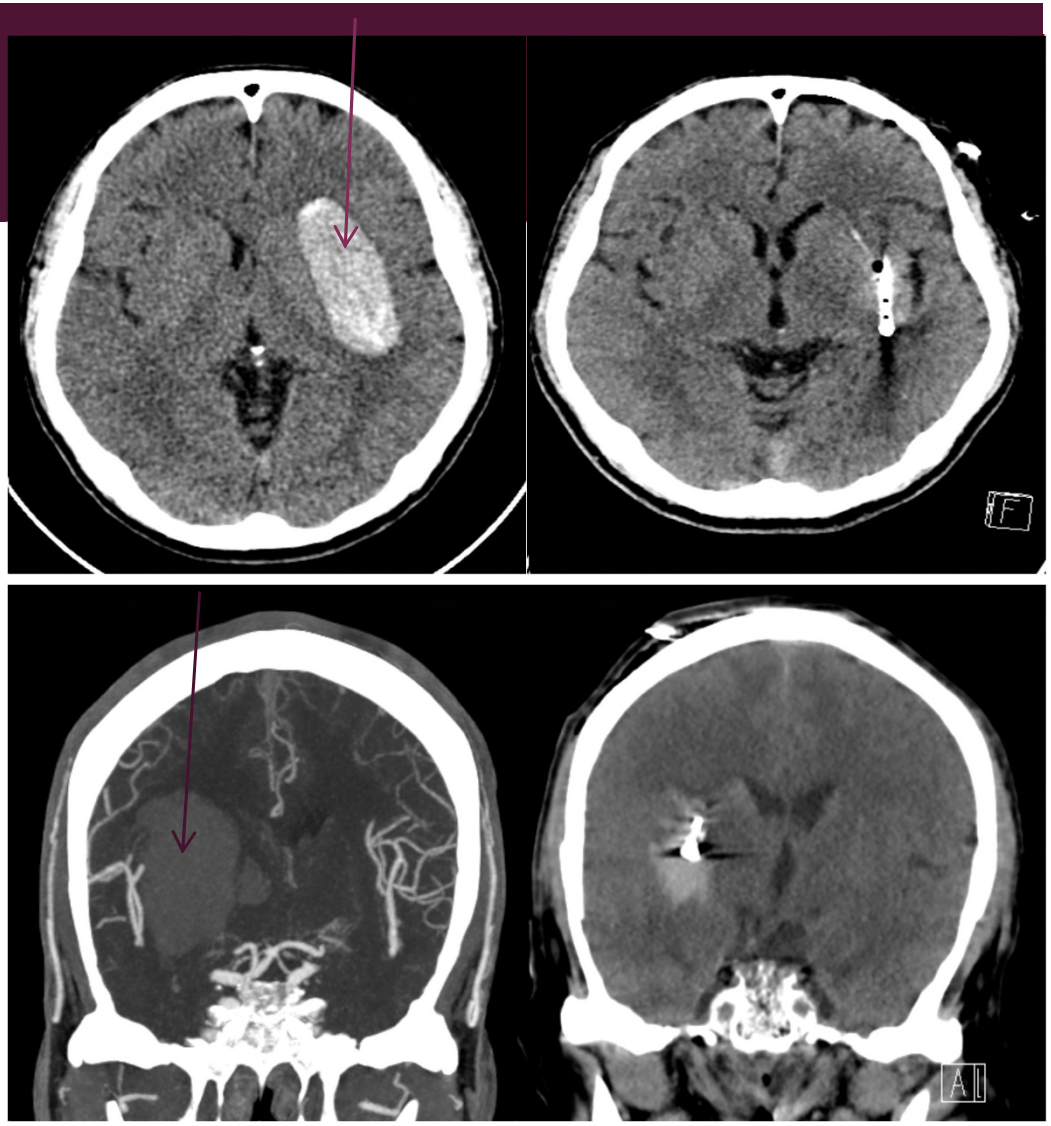

Two trajectories

- **Kocher's point (KP)**
  - Blue
  - Conventional
  - Lateral ventricle access
- **Supraorbital keyhole point (SOK)**
  - Orange
  - Recently tried
  - Supraorbital keyhole ventriculostomy



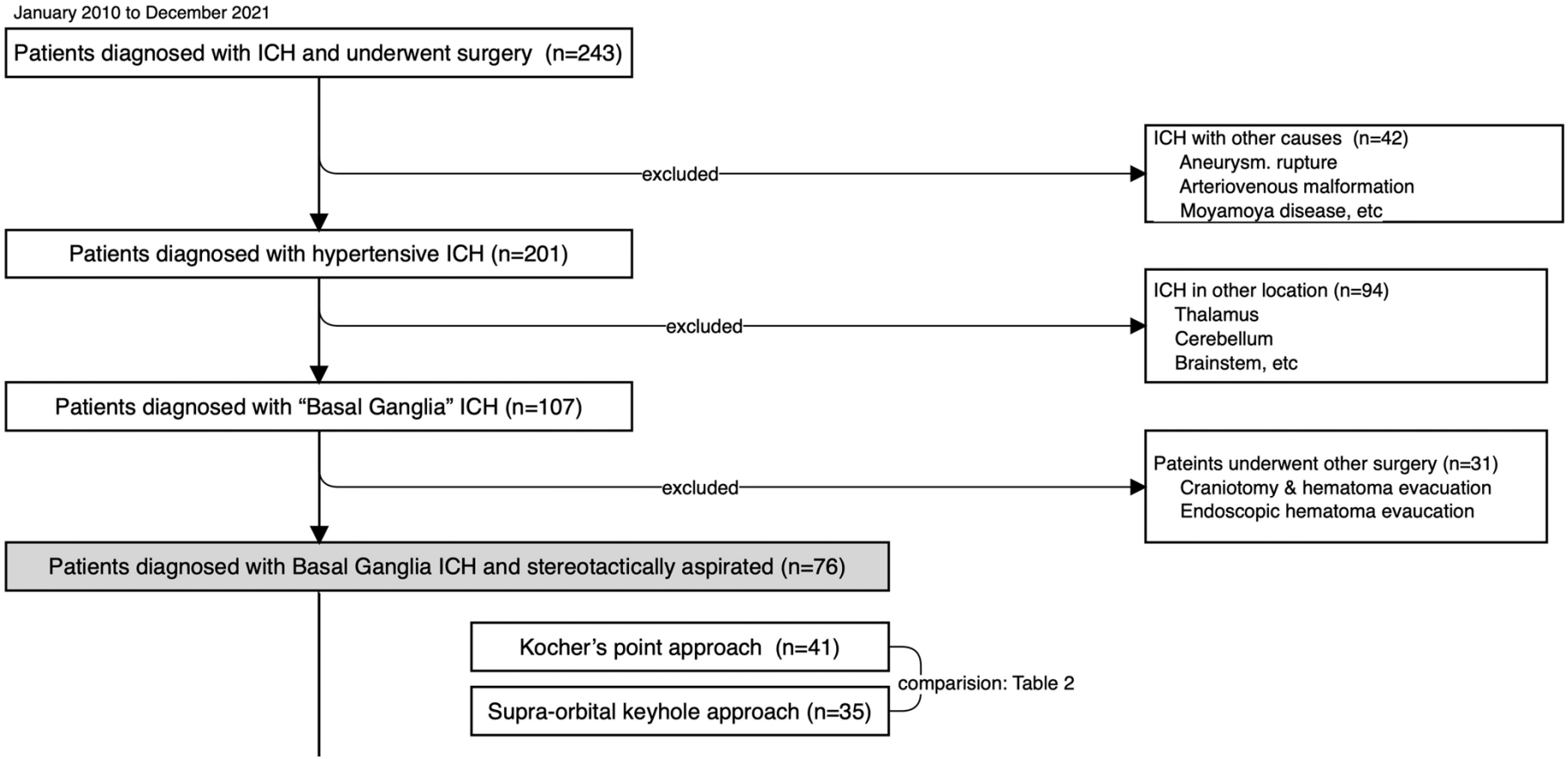
# BACKGROUNDS

- **Basal ganglia**
  - Average length: 41 to 47mm
  - Far longer than the height (about 20mm)
  - Supraorbital keyhole point (SOK): AP trajectory
  - Kocher's point approach (KP): SI trajectory
- Hypothesis
  - catheter placed with longer diameter of anterior-to-posterior (A-P) direction (SOK approach) can contact the largest diameter within the hematoma and present the higher aspiration rate than that of catheter with superior-to-inferior (S-I) direction (KP approach)



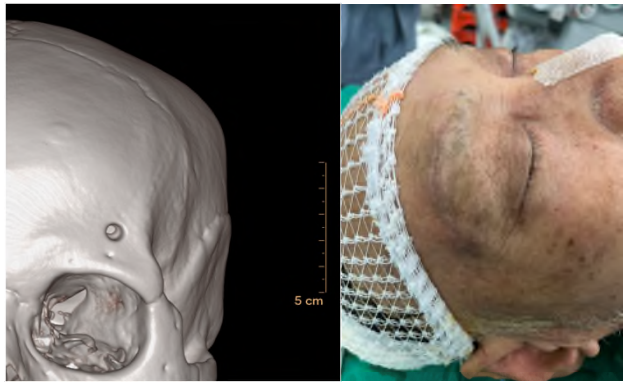
Hernando RAFAEL GP, Pedro MOROMIZATO. SURGICAL ANATO MY OF THE PUTAMEN. *Turkish Neurosurgery*. 1993; Vol 3 (Num 1):11 -14.

# PATIENT ENROLLMENT



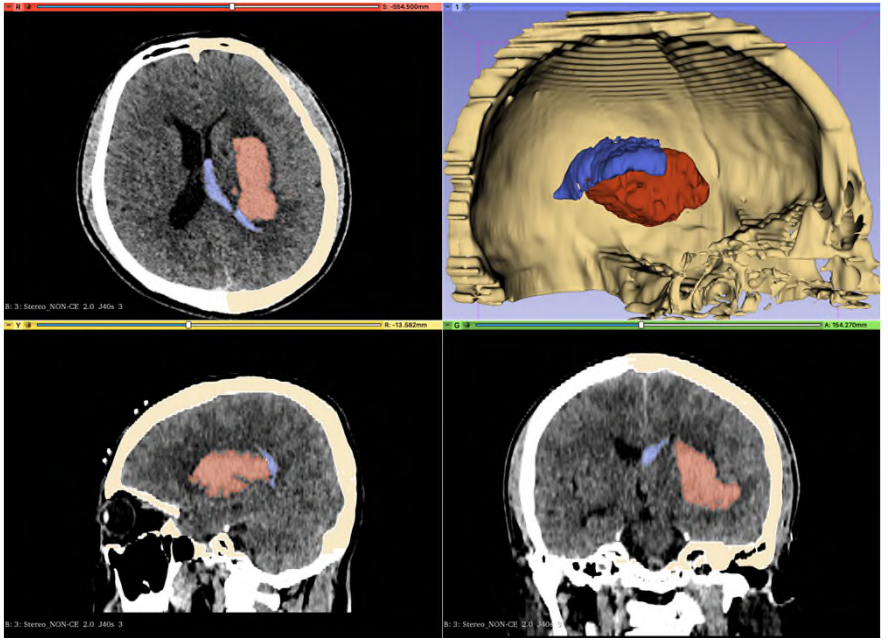
# SURGERY

- Thin-sliced CT (1~1.5mm)
- EM navigation (Stealth)
- Small eyebrow incision
  - Supraciliary
- Small burr-hole
- Longest trajectory




# HEMATOMA VOLUME MEASUREMENT

- Most important
- Only ICH segmentation
- 3D Slicer (https://www.slicer.org)
- Independent two surgeons: median

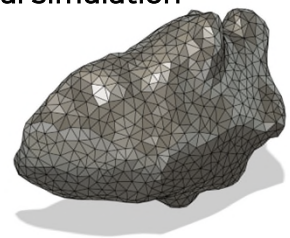


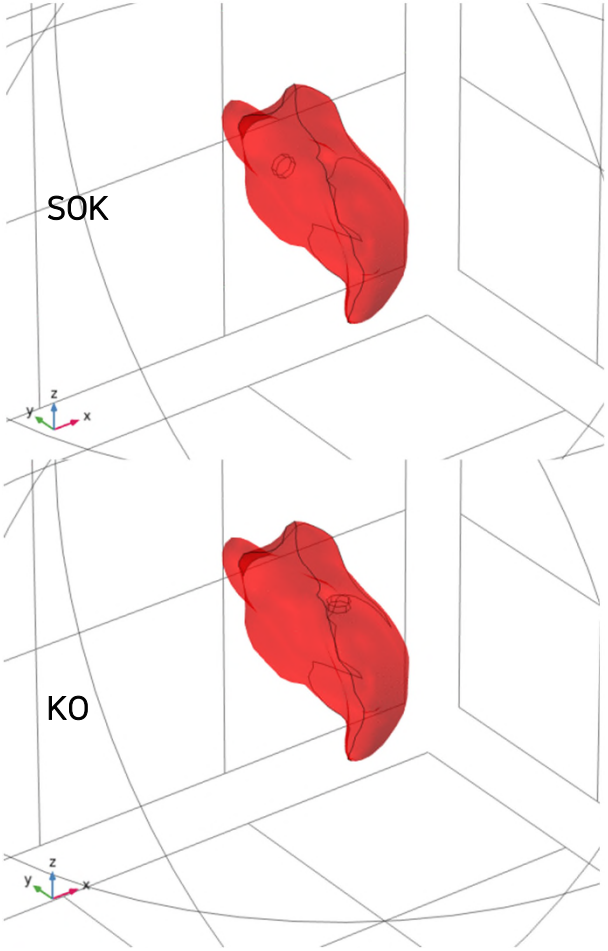
# COMPARISON ANALYSIS: OUTCOME

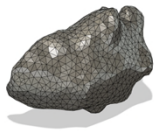
- Efficacy
  - Aspiration rate: KP 38% vs. SOK 51% (p=0.077)
  - Clinical outcome: no significant differences
- Safety
  - No incision-related complication
    - Brow ptosis, frontalis palsy, forehead dysesthesia
  - Catheter positioning: SOK better (no sig.)
  - Cath-related bleeding: KP better (no sig.)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Operation findings | | | | | | | | | |
| OP timing | within 4 hours | 12 | 29.3% | 10 | 28.6% | | | | .294 |
| | within 8 hours | 13 | 31.7% | 8 | 22.9% | | | | |
| | within 24 hours | 16 | 39.0% | 15 | 42.9% | | | | |
| | after 24 hours | 0 | 0.0% | 2 | 5.7% | | | | |
| Axis injury | | 5 | 12.2% | 2 | 5.7% | .436 | .079 | 2.404 | .330 |
| Surgical complications | No complication | 32 | 78.0% | 28 | 80.0% | | | | .665 |
| | Poor catheter positioning | 7 | 17.1% | 4 | 11.4% | | | | |
| | Catheter-related bleeding | 2 | 4.9% | 3 | 8.6% | | | | |
| Catheter positioning | Good | 19 | 46.3% | 21 | 60.0% | | | | .397 |
| | Moderate | 15 | 36.6% | 8 | 22.9% | | | | |
| | Poor | 7 | 17.1% | 6 | 17.1% | | | | |
| Contralateral EVD placement | | 2 | 4.9% | 1 | 2.9% | .574 | .050 | 6.607 | .652 |
| Radiologic outcomes | | | | | | | | | |
| Volume | | 25.6185 | 14.45401 | 23.3523 | 20.75784 | 2.26625 | -5.81916 | 10.35166 | .578 |
| delta | | 16.23366 | 13.487810 | 20.00857 | 12.018228 | -3.774913 | -9.659746 | 2.109920 | .205 |
| percent | | 38.49223 | 30.798979 | 50.71406 | 28.047297 | -12.221824 | -25.779608 | 1.335961 | .077 |
| Clinical outcomes | | | | | | | | | |
| ICU stay | | 15.73 | 12.734 | 19.54 | 16.646 | -3.811 | -10.534 | 2.912 | .262 |
| Hospital stay | | 42.17 | 20.927 | 41.17 | 18.663 | .999 | -8.135 | 10.133 | .828 |
| GOS at discharge | | 3.39 | 1.137 | 3.37 | 1.060 | .019 | -.487 | .524 | .941 |
| | 1 | 3 | 7.3% | 2 | 5.7% | | | | .957 |
| | 2 | 3 | 7.3% | 3 | 8.6% | | | | |
| | 3 | 19 | 46.3% | 16 | 45.7% | | | | |
| | 4 | 7 | 17.1% | 8 | 22.9% | | | | |
| | 5 | 9 | 22.0% | 6 | 17.1% | | | | |
| mRS (3mo) | | 3.32 | 1.588 | 3.00 | 1.680 | .317 | -.431 | 1.065 | .401 |
| | 0~1 | 8 | 19.5% | 10 | 28.6% | | | | .782 |
| | 2 | 3 | 7.3% | 4 | 11.4% | | | | |
| | 3 | 12 | 29.3% | 8 | 22.9% | | | | |
| | 4 | 9 | 22.0% | 5 | 14.3% | | | | |
| | 5 | 4 | 9.8% | 5 | 14.3% | | | | |
| | 6 | 5 | 12.2% | 3 | 8.6% | | | | |
| mRS (6mo) | | 3.07 | 1.603 | 2.89 | 1.694 | .187 | -.567 | .942 | .622 |
| | 0~1 | 9 | 22.0% | 10 | 28.6% | | | | .836 |
| | 2 | 6 | 14.6% | 7 | 20.0% | | | | |
| | 3 | 11 | 26.8% | 5 | 14.3% | | | | |
| | 4 | 8 | 19.5% | 7 | 20.0% | | | | |
| | 5 | 2 | 4.9% | 2 | 5.7% | | | | |
| | 6 | 5 | 12.2% | 4 | 11.4% | | | | |

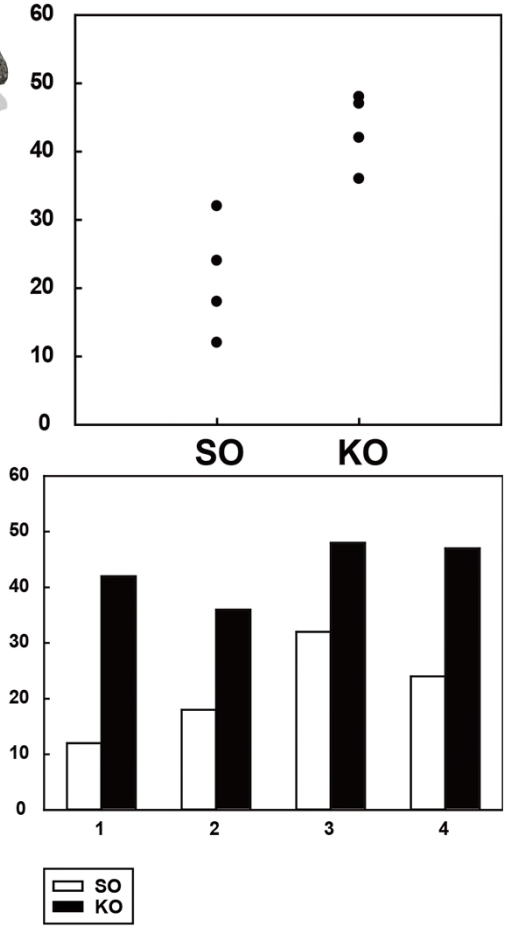
Computational simulation

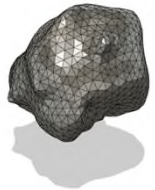




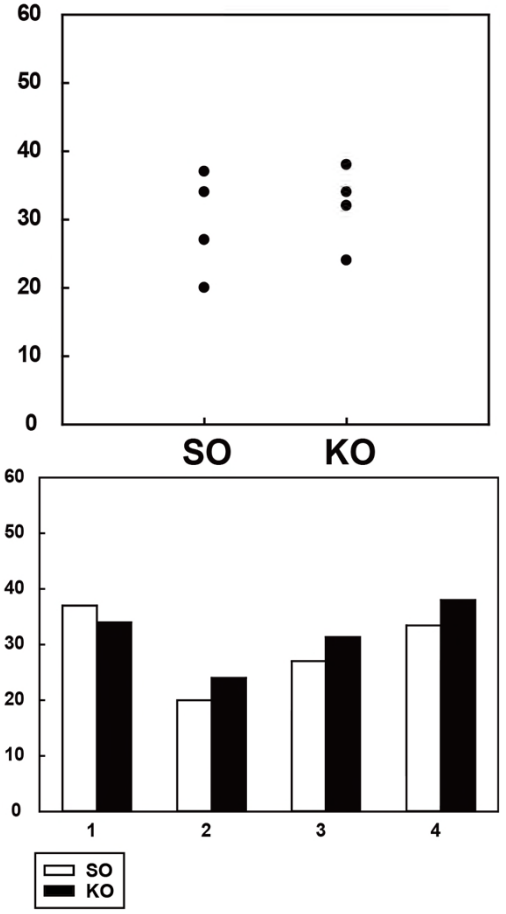



Typical



Atypical




**Conclusion:**

**SOK > KP: Better approaches in typical basal ganglia ICH**

- Aspiration rate: better in SOK (significant in typical ICH): **Clinical and computationally verified**
- Clinical outcome: better in SOK (significant in typical ICH)
- Safety: no incision related complication