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Porcine Knee Arthroscopy Laboratory – A Viable Alternative for Training Arthroscopic Surgical Techniques Using Anatomical Models Similar to the Human Knee

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Faculty Disclosure Information

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INTRODUCTION

- Arthroscopic knee surgery is a widely adopted technique in orthopedics due to its minimally invasive nature and enhanced visualization of intra-articular structures [Sweeney, 1982; Slade Shantz et al., 2014].
- However, it presents a steep learning curve and requires advanced motor coordination, hand-eye skills, and instrument triangulation [Koehler et al., 2013].
- While human cadaveric specimens provide realistic training, they are often scarce due to ethical and logistical limitations, especially in countries like Brazil and Australia [Martin et al., 2016; Kovac et al., 2015].
- Virtual simulators offer repetition and structured learning, but their high cost and limited realism for fluid management and tactile feedback reduce their effectiveness [Jacobsen et al., 2015; Fucentese et al., 2014].
- Animal models, especially porcine knees, have emerged as anatomically and functionally viable substitutes for arthroscopic training [Voto et al., 1998; Proffen et al., 2012].

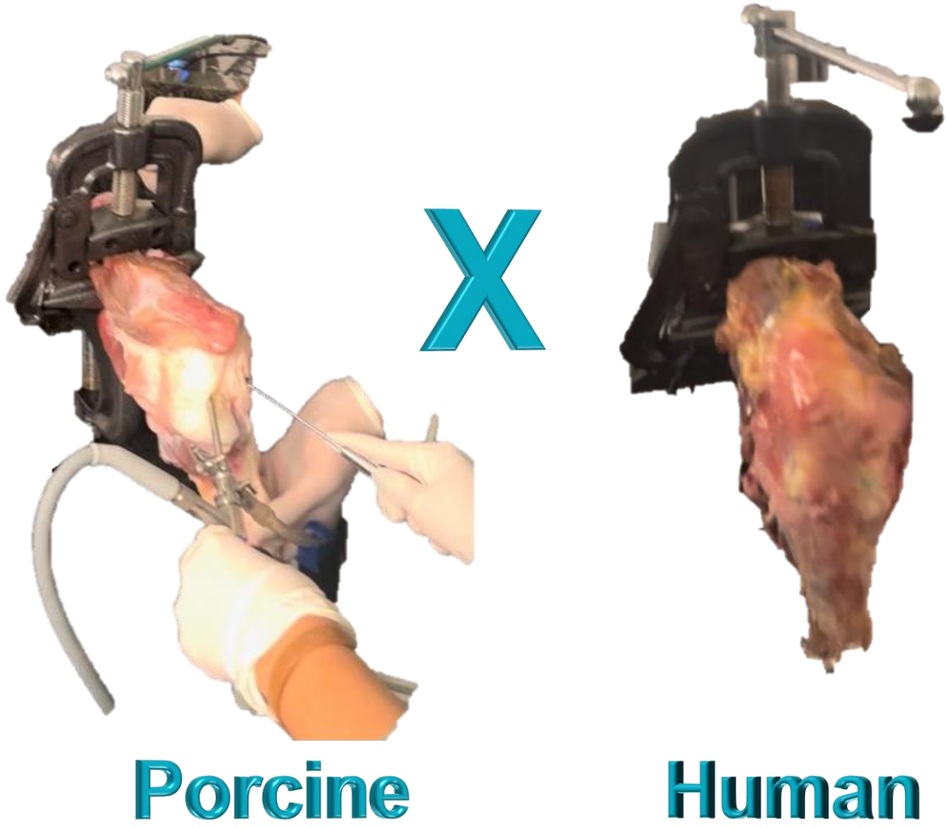
OBJECTIVE

Main Objective:

- To evaluate the effectiveness of arthroscopic training using porcine knee models compared to human knees from a tissue bank.

Specific Goals:

- Measure performance improvements in arthroscopic tasks.
- Compare perceived similarity between porcine and human knees.
- Assess viability of porcine knees for skill acquisition in real surgical settings.



STUDY DESIGN

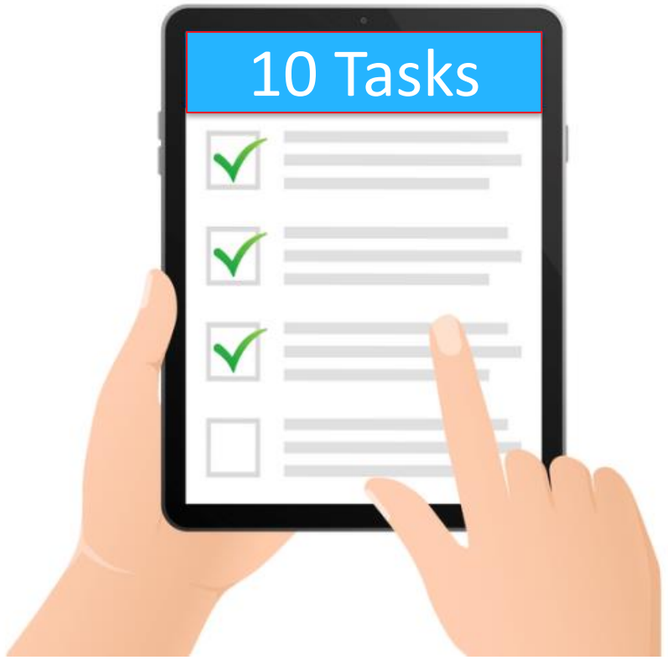
Type: Prospective, longitudinal, observational.

Participants: 30 orthopedic residents (PGY-1, PGY-2, PGY-3) and 5 experienced knee surgeons (≥5 years Brazilian Society of Knee Surgery).

Setting: Arthroscopy LAB at National Institute of Traumatology and Orthopaedics – INTO.

Tools:

- 10-task checklist (Koehler et al.)
- ASSET tool for skill evaluation
- Session timing for completing 10 tasks
- Similarity questionnaire (0–100%)



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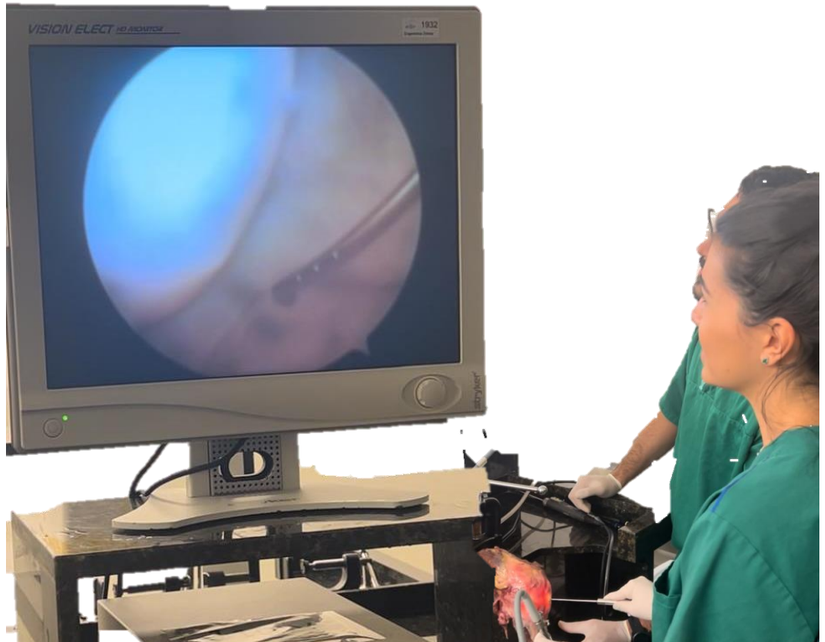
TRAINING PROTOCOL

- 3 sessions per participant (one per week), using both human and porcine knee models.
- Tasks included anatomical inspection and probing of the patellofemoral joint, cruciate ligaments, menisci, and cartilage surfaces.
- Each session timed and evaluated by a single trained observer.
- Models alternated across sessions to assess learning curve and anatomical adaptability.



MATERIALS

Porcine Knees:

- Obtained from certified meat distributors.
- Osteotomy at 15 cm distal to knee joint, stored at -20°/-80°C.
- Reused for up to 12 arthroscopies.

Human Knees:

- From INTO’s tissue bank.
- Disqualified for clinical use due to contamination.
- Ethical use ensured via institutional protocol.

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RESULTS: PGY 1 RESIDENTS

Human knee model:

Initial: 199.2s (3min 19s) → Final: 97.4s (1min 37s)

Porcine knee model:

Initial: 185s (3min 5s) → Final: 93.11s (1min 33s)

Significant skill improvement with both models.

$p < 0.05$

RESULTS: PGY-2 AND PGY-3 RESIDENTS

PGY-2:

Human: 242s (4min 2s) → 70.6s (1min 11s)

Porcine: 213.44s (3min 33s) → 102.22s (1min 42s)

PGY-3:

Human: 94.2s (1min 34s) → 58.9s (59s)

Porcine: 135.9s (2min 16s) → 76.2s (1min 16s)

Consistent improvements across both training models.

$p < 0.05$

RESULTS: EXPERIENCED SURGEONS

Results: Experienced Surgeons

Human model: 45.8s → 30.4s

Porcine model: 42.8s → 37s

All surgeons reported high similarity (≥75%) between models.

CONCLUSION

- Arthroscopic training using porcine models is an **efficient, accessible, and realistic alternative**.
- Facilitates acquisition of essential skills.
- Encourages broad implementation in surgical education and innovation centers.

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