



ISAKOS
CONGRESS
2023



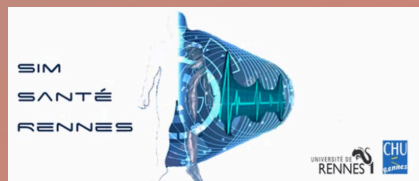
Boston
Massachusetts
June 18–June 21

Title:

**Virtual Reality Simulation is Valuable for
Arthroscopic Diagnosis and Meniscectomy:
A Transfer Validity Study of 36 Residents**

Author/s:

A Tronchet, MD PhD, T Casy, PhD, N Vallee, MD,
H Common, MD, H Thomazeau, Pr, MD,
A Huaulme, PhD





ISAKOS
CONGRESS
2023



Boston

Massachusetts
June 18–June 21

Disclosures:

Nothing to declare

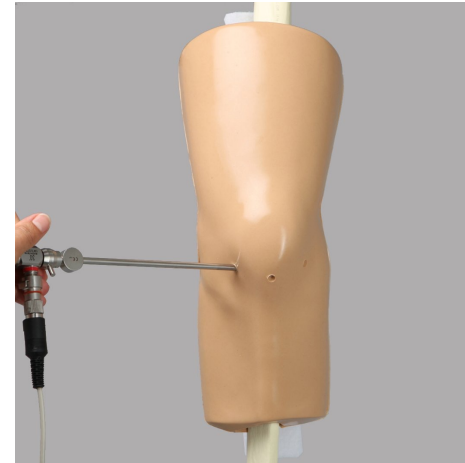


SIMULATION : PRIORITY OF SURGICAL TRAINING

Cadaver



Bench-Top



Virtual Reality Simulator



Immersive VR



BENEFIT OF VR SIMULATION: THE FOLLOW-UP

- ✓ Trainee Progress with simple metrics on the simulator



ISAKOS
CONGRESS
2023



Boston
Massachusetts
June 18–June 21

LIMIT OF VR SIMULATION: STILL TO PROVE TRANSFER COMPETENCY

- × Very few studies have evaluated the transfer of skills acquired on a VR simulator to the operating room

IT IS NECESSARY TO EVALUATE THE
PEDAGOGICAL INTEREST!

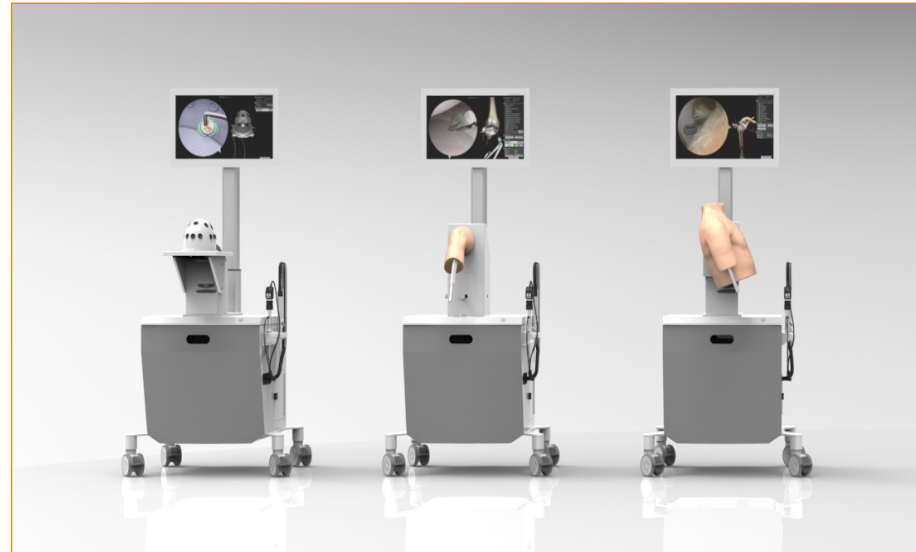


ISAKOS
CONGRESS
2023



Boston
Massachusetts
June 18–June 21

PROJECT'S GOAL



- ⇒ **Can we acquire technical surgical skills in arthroscopy with a VR simulator?**
- ⇒ *How can we judge the learner's competence (vs. "simulator performance")?*

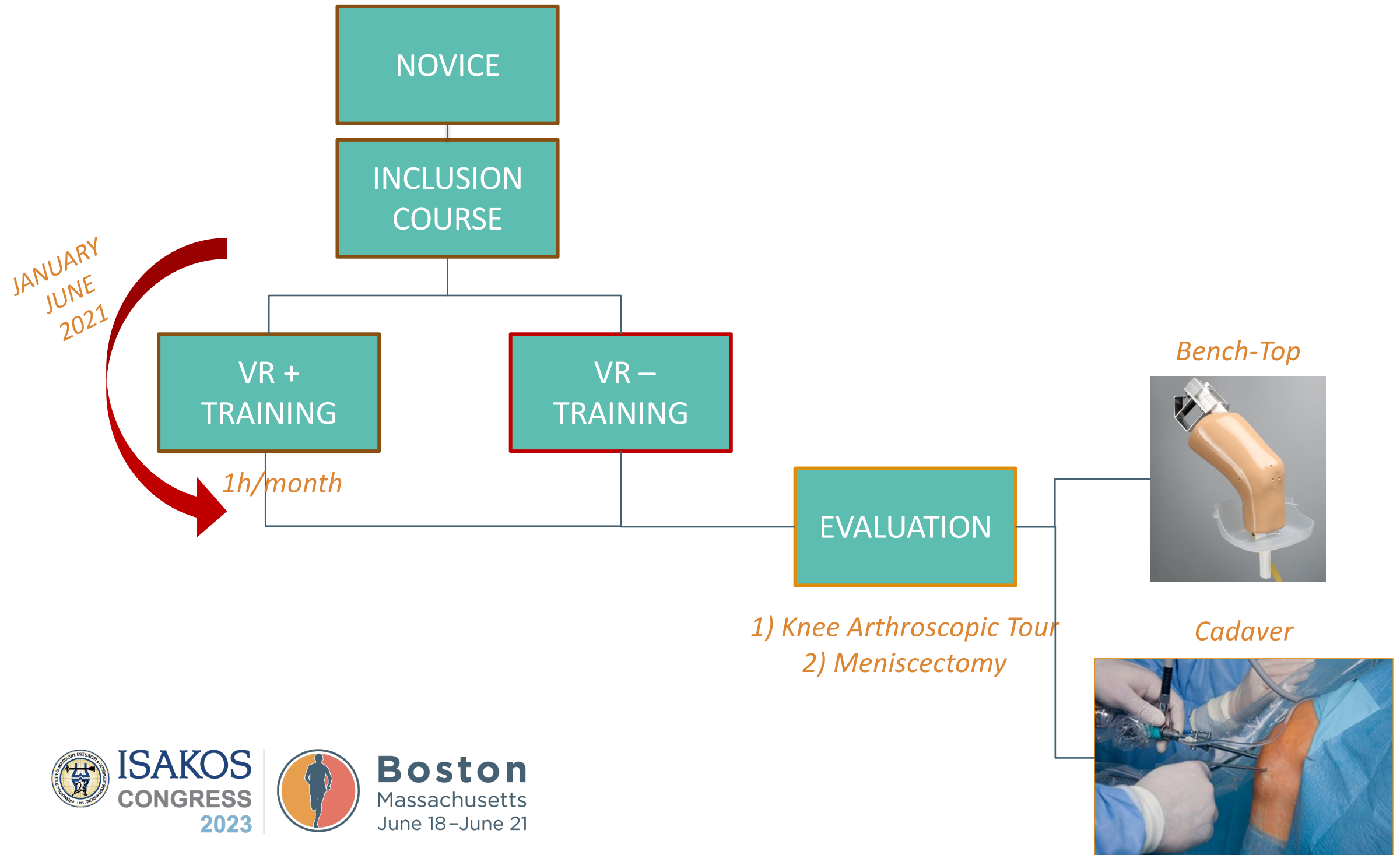


ISAKOS
CONGRESS
2023



Boston
Massachusetts
June 18–June 21

TRANSFER VALIDITY STUDY



ISAKOS
CONGRESS
2023



Boston
Massachusetts
June 18 - June 21

BASELINE CHARACTERISTICS OF PARTICIPANTS

36 residents (PGY 1 & 2)

Table 1. Baseline characteristics of participants at inclusion

	NON VR TRAINING VR- (n=20)	VR TRAINING VR+ (n=16)	TOTAL (n=36)	P-VALUE
AGE, an	25.3 [24-27]	25.4 [24-29]	25.3 [24-29]	0.77*
SEXE				0.48†
<i>Male</i>	13 (65%)	13 (81.2%)	26 (72.2%)	
<i>Female</i>	7 (35%)	3 (18.8%)	10 (27.8%)	
DOMINANT SIDE				1†
<i>Right</i>	17 (85%)	14 (87.5%)	31 (86.1%)	
<i>Left</i>	3 (15%)	2 (12.5%)	5 (13.9%)	
<i>Ambidextrous</i>	0 (0%)	0 (0%)	0 (0%)	
YEAR OF RESIDENCY				1†
<i>PGY-1</i>	10 (50%)	8 (50%)	18 (50%)	
<i>PGY-2</i>	10 (50%)	8 (50%)	18 (50%)	
ARTHROSCOPIC EXPERIENCE				
Surgical Assistant (< 100 arthroscopies)				0.91†
<i>Yes</i>	20 (100%)	15 (93.8%)	35 (97.2%)	
<i>No</i>	0 (0%)	1 (6.2%)	1 (2.8%)	
Principal operator (< 5 arthroscopies)				0.96†
<i>Yes</i>	5 (25%)	3 (18.8%)	8 (22.2%)	
<i>No</i>	15 (75%)	13 (81.2%)	28 (77.8%)	
ARTHROSCOPIC TRAINING				0.95†
<i>Yes (Cadaveric Model)</i>	3 (15%)	3 (18.8%)	6 (16.7%)	
<i>Yes (1h, Bench-Top Model)</i>	3 (15%)	2 (13.2%)	5 (13.9%)	
<i>No</i>	14 (70%)	11 (68.8%)	25 (69.4%)	
SIMULATOR TRAINING at inclusion				0.94†
<i>Yes</i>	6 (M :4.8h) (30%)	5 (M :7.2h) (31.2%)	11 (M :5.5h) (30.6%)	
<i>No</i>	14 (70%)	11 (68.8%)	25 (69.4%)	
VR ARTHROSCOPIC SIMULATOR SCORE AT INCLUSION				
FAST MODULE PROGRAM	492 [434-550]	453 [350-556]	486 [393-579]	0.05*
KNEE MODULE PROGRAM	125 [116-134]	123 [111-135]	124 [113-135]	0.14*

NOTE. Data are reported as median [interquartile range] or number (percentage).

* Independent-samples Student's t-test

† Pearson's chi-squared test

Table 2. Baseline characteristics of participants at evaluation

	NON VR TRAINING VR- (n=20)	VR TRAINING VR+ (n=16)	TOTAL (n=36)	P-VALUE
ARTHROSCOPIC EXPERIENCE				
Surgical Assistant (< 100 arthroscopies)				1†
<i>Yes</i>	18 (90%)	14 (87.5%)	32 (88.9%)	
<i>No</i>	2 (10%)	2 (12.5%)	4 (11.1%)	
Principal operator (< 5 arthroscopies)				0.23†
<i>Yes</i>	5 (25%)	8 (50%)	13 (36.1%)	
<i>No</i>	15 (75%)	8 (50%)	23 (63.9%)	
ARTHROSCOPIC TRAINING				0.48†
<i>Yes (Cadaveric Model)</i>	0 (0%)	0 (0%)	0 (0%)	
<i>Yes (1h, Bench-Top Model)</i>	4 (20%)	1 (6.2%)	5 (13.9%)	
<i>No</i>	16 (80%)	15 (93.8%)	31 (86.1%)	
FEELING PROGRESS IN ARTHROSCOPIC SKILLS				< 0.001†
<i>Yes</i>	7 (35%)	16 (100%)	23 (63.9%)	
<i>No</i>	13 (65%)	0 (0%)	13 (36.1%)	

NOTE. Data are reported as number (percentage).

† Pearson's chi-squared test

HOW TO EVALUATE THE TRAINEE ?

The American Journal of Sports Medicine



The Arthroscopic Surgical Skill Evaluation Tool (ASSET)

	1 – Novice	2	3 - Competent	4	5- Expert
Safety	Significant damage to articular cartilage or soft tissue		Insignificant damage to articular cartilage or soft tissue		No damage to articular cartilage or soft tissue
Field of View	Narrow field of view, inadequate arthroscope or light source positioning		Moderate field of view, adequate arthroscope and light source positioning		Expansive field of view, optimal arthroscope and light source positioning
Camera Dexterity	Awkward or graceless movements, fails to keep camera centered and correctly oriented		Appropriate use of camera, occasionally needs to reposition		Graceful and dexterous throughout procedure with camera always centered and correctly oriented
Instrument Dexterity	Overly tentative or awkward with instruments, unable to consistently direct instruments to targets		Careful, controlled use of instruments, occasionally misses targets		Confident and accurate use of all instruments
Bi-Manual Dexterity	Unable to use both hands or no coordination between hands		Uses both hands but occasionally fails to coordinate movement of camera and instruments		Uses both hands to coordinate camera and instrument positioning for optimal performance
Flow of Procedure	Frequently stops operating or persists without progress, multiple unsuccessful attempts prior to completing tasks		Steady progression of operative procedure with few unsuccessful attempts prior to completing tasks		Obviously planned course of procedure, fluid transition from one task to the next with no unsuccessful attempts
Quality of Procedure	Inadequate or incomplete final product		Adequate final product with only minor flaws that do not require correction		Optimal final product with no flaws

✓ 2 external "single blind" evaluators

✓ Experts in arthroscopic knee surgery

✓ *Pr Philippe BEAUFILS*

✓ *Dr Philippe COLOMBET*

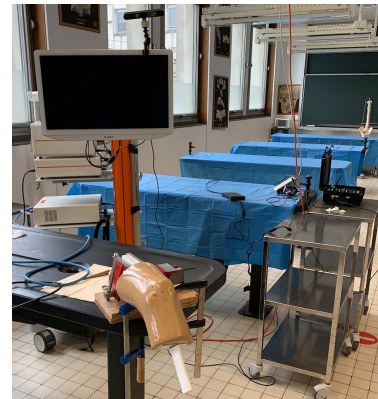


ISAKOS
CONGRESS
2023

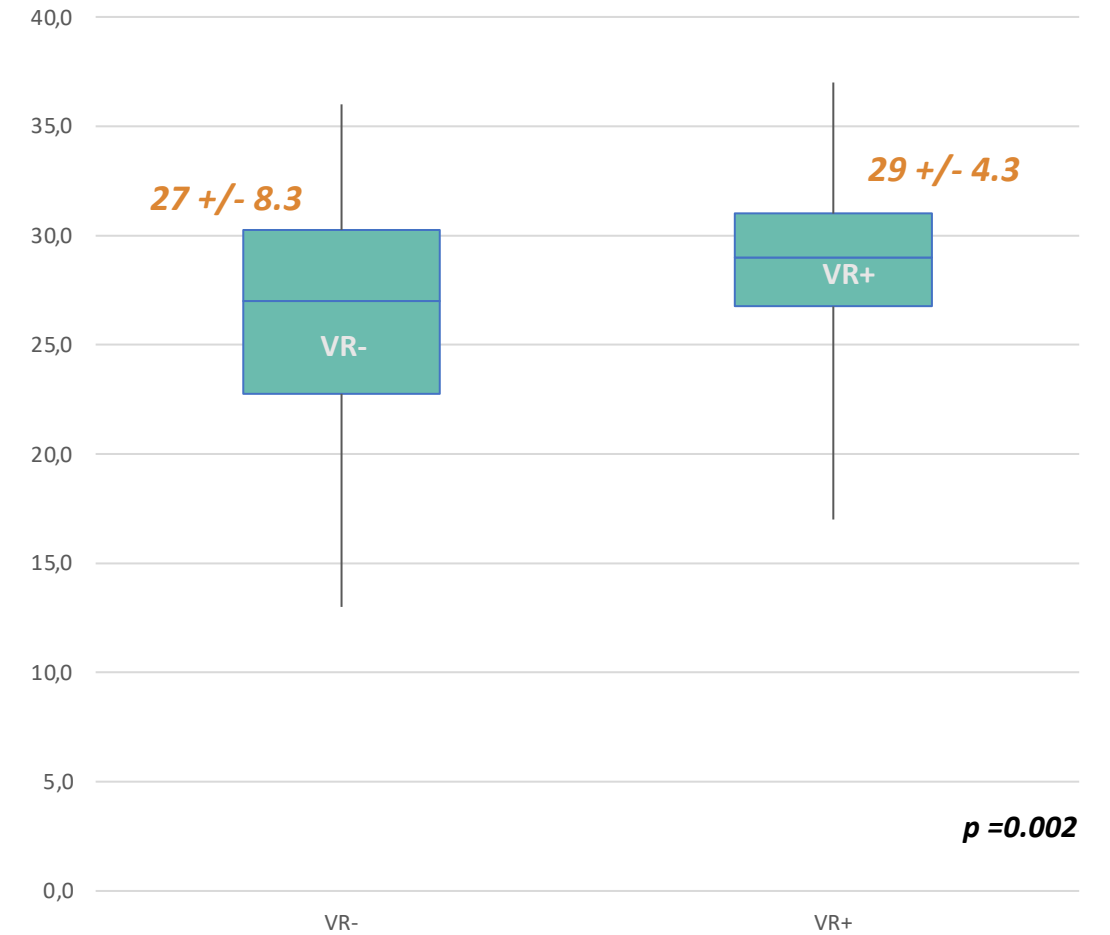


Boston
Massachusetts
June 18 – June 21

CONFIRMED PROGRESS ON BENCH-TOP & CADAVERIC MODELS

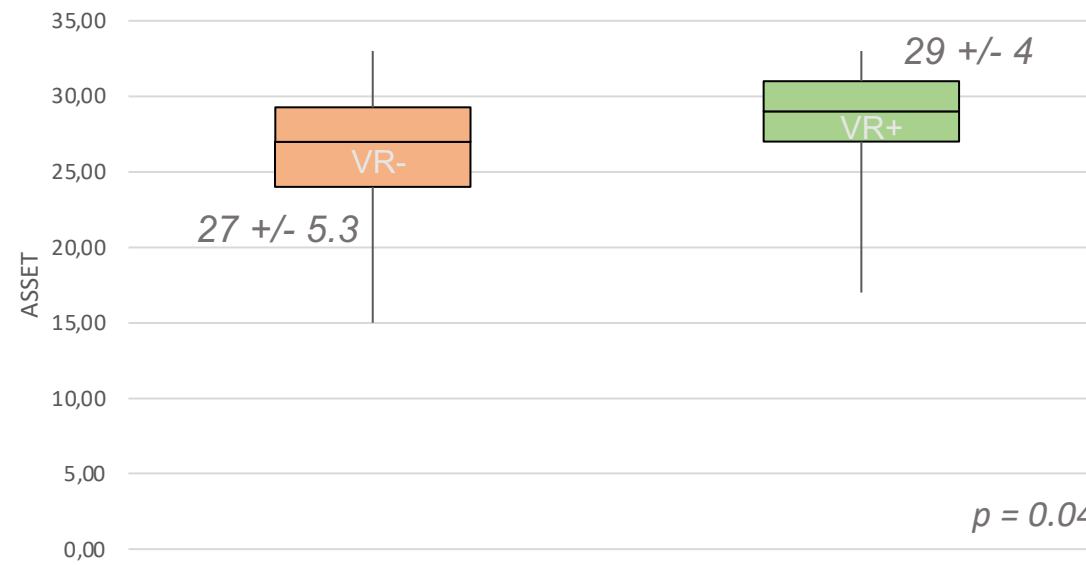


ASSET FR GLOBAL

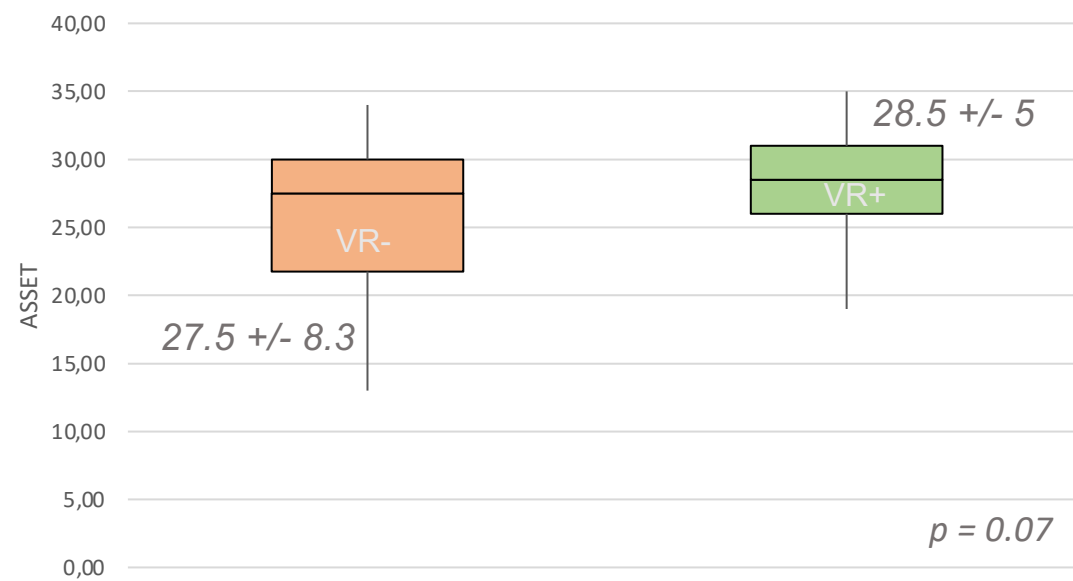


RESULTS FOR EACH EXERCISE

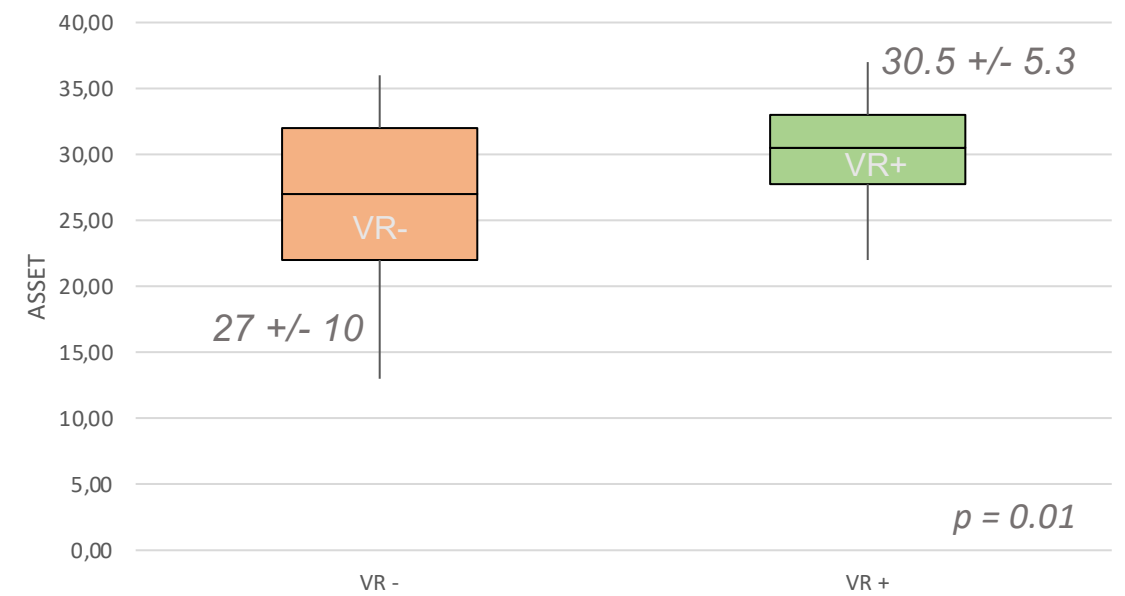
BENCH-TOP MENISCECTOMY



CADAVER KNEE DIAGNOSTIC TOUR



CADAVER KNEE MENISCECTOMY



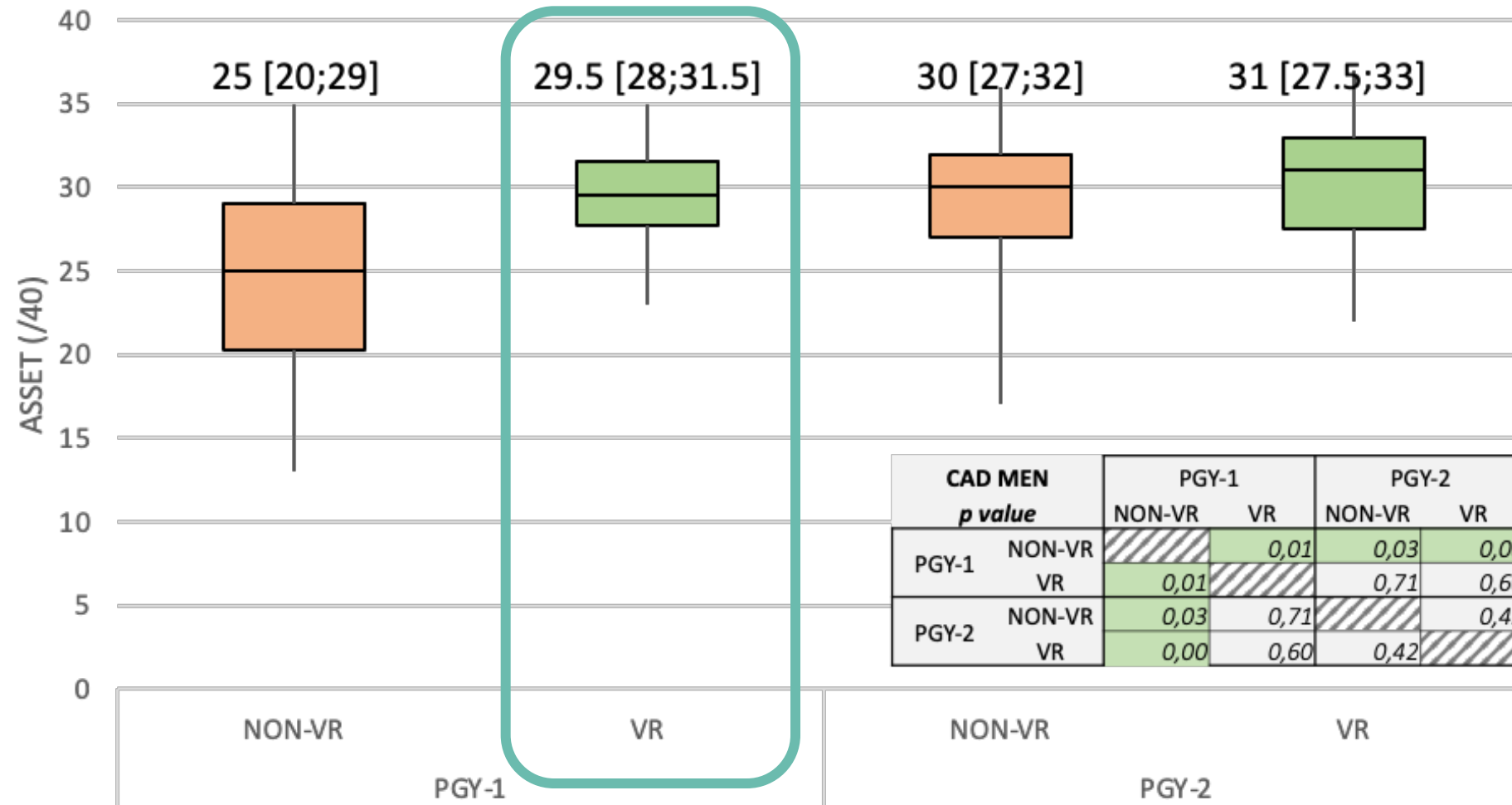
ISAKOS
CONGRESS
2023



Boston
Massachusetts
June 18-June 21

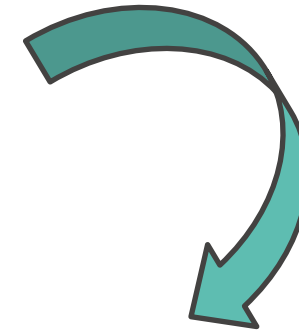
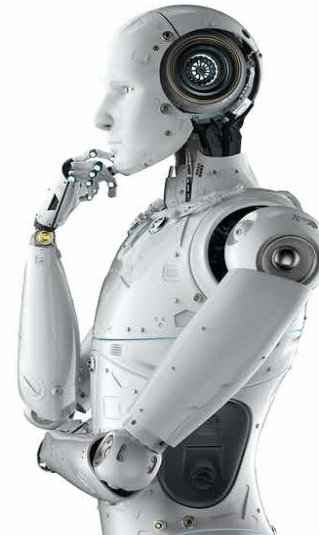
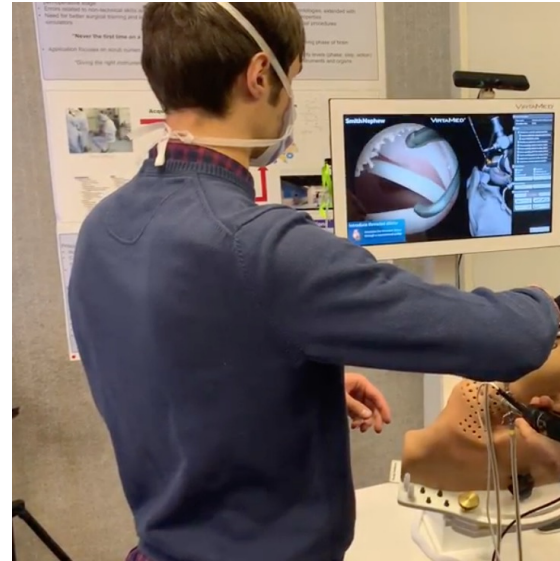
GREAT IMPROVEMENT FOR PGY-1 !

c) Meniscectomy on a cadaveric knee



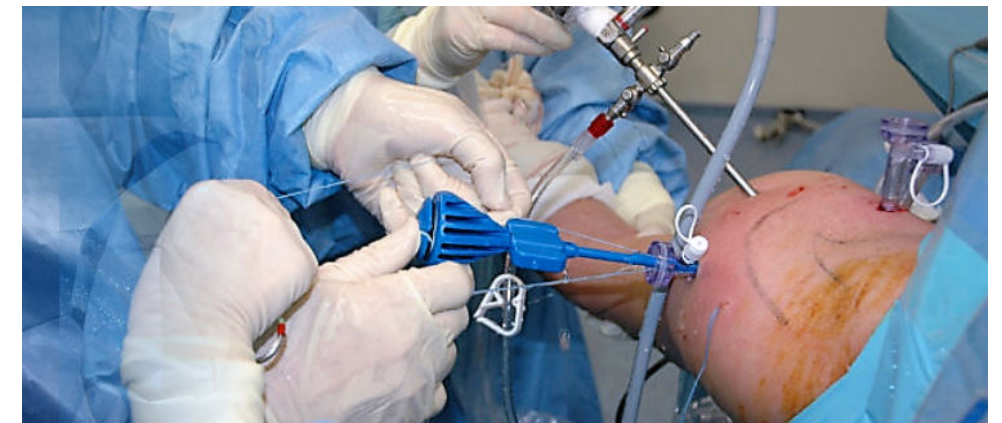
CONCLUSION

FROM THE SIMULATOR



TO THE OPERATING ROOM

AN EFFICIENT TOOL FOR FELLOWSHIP TRAINING !



ISAKOS
CONGRESS
2023



Boston
Massachusetts
June 18 - June 21



Thank you !

References :

- [1] Burrus MT, Werner BC, Griffin JW, Gwathmey FW, Miller MD. Diagnostic and Management Strategies for Multiligament Knee Injuries: A Critical Analysis Review. JBJS Rev 2016;4. <https://doi.org/10.2106/JBJS.RVW.O.00020>.
- [2] Cook S, Ridley TJ, McCarthy MA, Gao Y, Wolf BR, Amendola A, et al. Surgical treatment of multiligament knee injuries. Knee Surg Sports Traumatol Arthrosc 2015;23:2983–91. <https://doi.org/10.1007/s00167-014-3451-1>.
- [3] LaPrade RF, Chahla J, DePhillipo NN, Cram T, Kennedy MI, Cinque M, et al. Single-Stage Multiple-Ligament Knee Reconstructions for Sports-Related Injuries: Outcomes in 194 Patients. Am J Sports Med 2019;47:2563–71. <https://doi.org/10.1177/0363546519864539>.
- [4] Axibal DP, Yeatts NC, Hysong AA, Hong IS, Trofa DP, Moorman CT, et al. Intraoperative and Early (90-Day) Postoperative Complications and Associated Variables with Multiligamentous Knee Reconstruction: 15-year Experience from a Single Academic Institution. Arthrosc J Arthrosc Relat Surg 2022;38:427–38. <https://doi.org/10.1016/j.arthro.2021.05.027>.
- [5] Fahlbusch H, Krivec L, Müller S, Reiter A, Frosch KH, Krause M. Arthrofibrosis is a common but poorly defined complication in multiligament knee injuries: a systematic review. Arch Orthop Trauma Surg 2022. <https://doi.org/10.1007/s00402-022-04730-9>.
- [6] Goebel CP, Domes C. Classifications in Brief: The Schenck Classification of Knee Dislocations. Clin Orthop 2020;478:1368–72. <https://doi.org/10.1097/CORR.0000000000001186>.



ISAKOS
CONGRESS
2023



Boston
Massachusetts
June 18–June 21