Validity Assessment of a 3D Printed Arthroscopic Shoulder Simulator : An Experimental Evaluation of Construct Validity of medical student versus novice and expert orthopaedic arthroscopy surgeons

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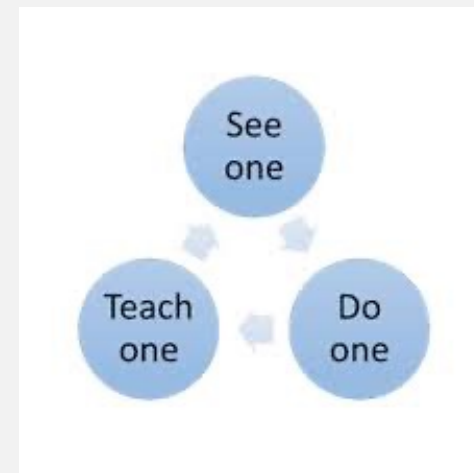
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ePoster: 152

Disclosure

The Authors have nothing to disclose

Background

- The Previous Teaching model is not sustainable
- Rising Cost of Training
- Restrictions on Training Hours

Simulation Training is standard for Training for Aviation

- **Learn From Mistakes**
- **Prevent Mistakes in a Real Airplane**
- **You can learn fundamentals in a low stress environment**

https://www.af.mil/News/Article-Display/Article/500033/simulators-train-aircrew-at-fraction-of-cost/

Time in Sim is more than a real plane

124 hours in a simulator

35 hours in a real plane

https://www.af.mil/News/Article-Display/Article/500033/simulators-train-aircrew-at-fraction-of-cost/

What are the barriers to Simulation Training?

- **80% of residents reported no Surgical skills lab at their training program for arthroscopy**
- **Lack of Funding as #1 Reason for no Surgical Simulation Training**
- **87 % of Orthopaedic Residency Program Directors Agreed**
- **Simulators Cost Too Much Money**
- **Implementation is too Expensive**

Karam, M. D., Pedowitz, R. A., Natividad, H., Murray, J., & Marsh, J. L. (2013). Current and future use of surgical skills training laboratories in orthopaedic resident education: a national survey. *JBJS*, *95*(1), e4.

Current Simulators

Type	Feedback	Cost	Cons
Cigar Box	👆	$44.00	Not Anatomic
Commercial Model	👂 👆 👁	$1200.00	Not Deployable 6 – 12 week Delivery time
Virtual Reality	👂 👁	$3500.00 / year	No Haptic Feedback
Virtual Reality with Model	👆 👂 👁	$114,000.00	Expensive High Maintenance

3D Printed Low Cost Arthroscopic Simulator

Advantages

- No Tools For Assembly Like Legos

- PLA Biodegradable

- Real Time Upgrades in Seconds

- Global Deployment

Purpose

- To evaluate the construct validity and educational value of a novel 3D printed arthroscopic shoulder simulator (3D-PASS) and compare to a widely adopted and commercially available shoulder simulator (CASS) across 3 different levels of training

Methods - 24 Subjects

4 Medical Students
4 Novice Surgeons
4 Expert Surgeons

4 Medical Students
4 Novice Surgeons
4 Expert Surgeons

4 Arthroscopic Tasks

Time to Completion

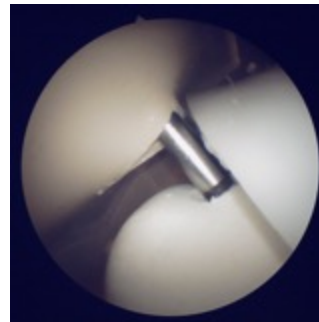Quality of Skills: ASSET

Anatomy Test

Baseline Test
Post Test

Expert Surgeons = >250 Shoulder arthroscopies
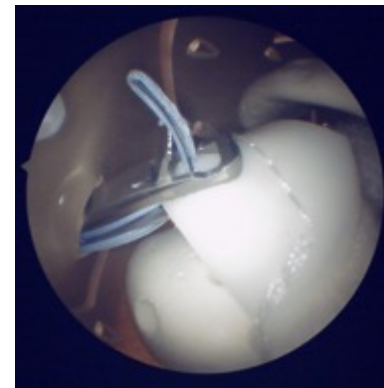
Methods : 4 Different Arthroscopic Tasks

Task1 - probing

Task 2 – suture anchor
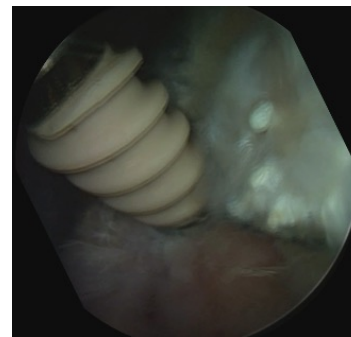

Task 3 – suture passer

Task 4 – measurments

3D Simulator versus Cadaver

Simulator

Real Shoulder

Results

Total seconds to complete arthroscopic shoulder simulator tasks on a 3DPASS and CASS

Expert and Novice were faster than medical Students on both simulators

Total Time to Complete Arthroscopic Shoulder Simulator Tasks (seconds)

	CASS	3DPASS
Medical Student	705	551
Novice Arthroscopy Orthopaedic Surgeon	477	360
Expert Arthroscopy Orthopaedic Surgeon	317	240

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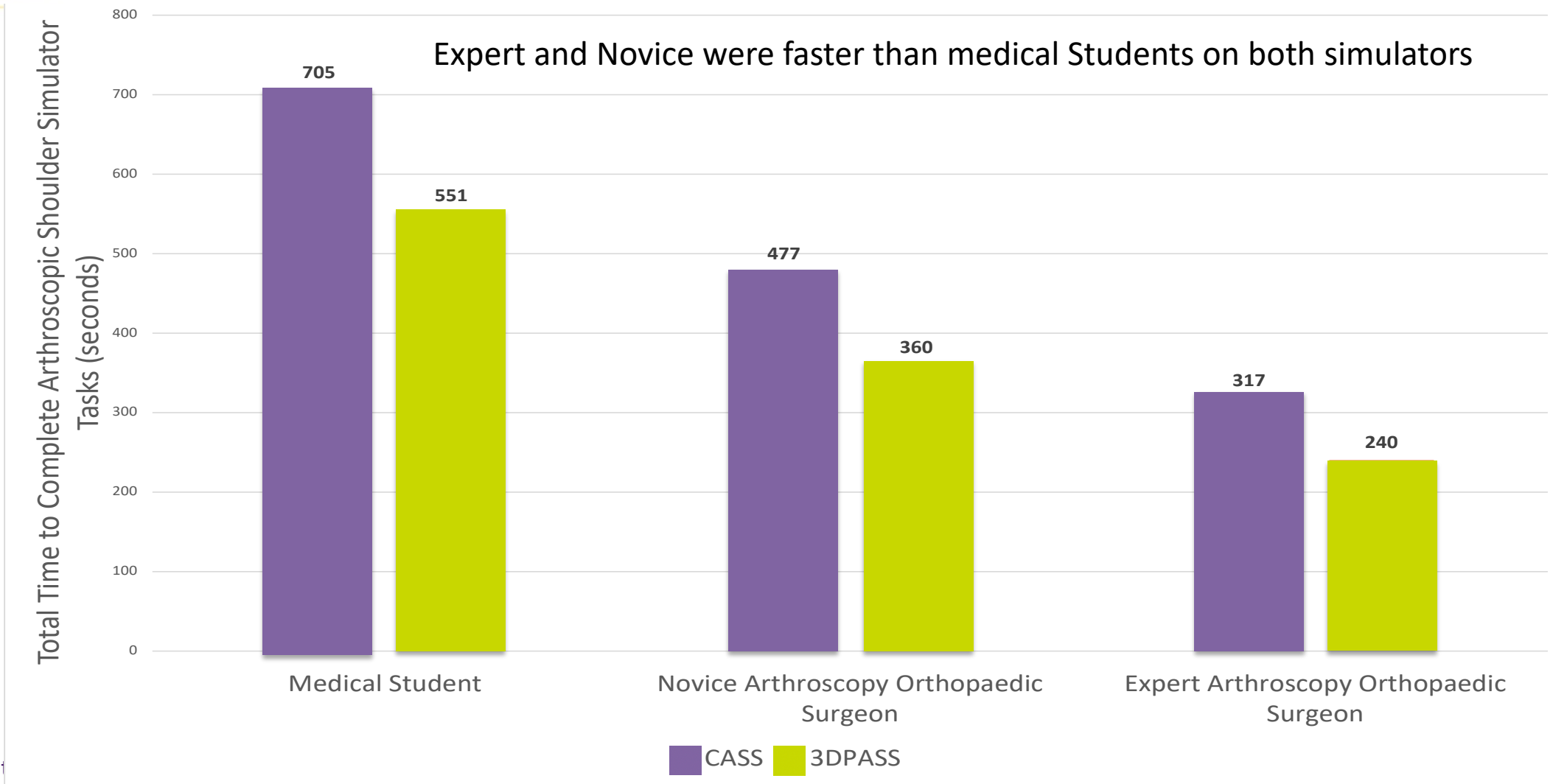
Results

- There was a difference in the time to completion of the simulation tasks among the three levels of training for the CASS and 3D-PASS (p=.002 and p=.014 respectively).

- On the 3D-PASS, expert surgeons and novice surgeons performed faster than medical students (p=.004 and p=.046 respectively).

- On the CASS, expert surgeons and novice surgeons performed faster than medical students (p=.001 and .013 respectively).

Results

ASSET on a 3D-Printed Arthroscopic Shoulder Simulator (3DPASS) and Commercially Available Shoulder Simulator (CASS)

- For 3D printed Simulator, Expert surgeons had higher ASSET than Novice and Med students (p=.02 and .001, respectively)
- No differences between ASSET among all 3 groups for CASS (p=.91)
- No difference between novice surgeons and medical students on 3DPASS (p=.55)
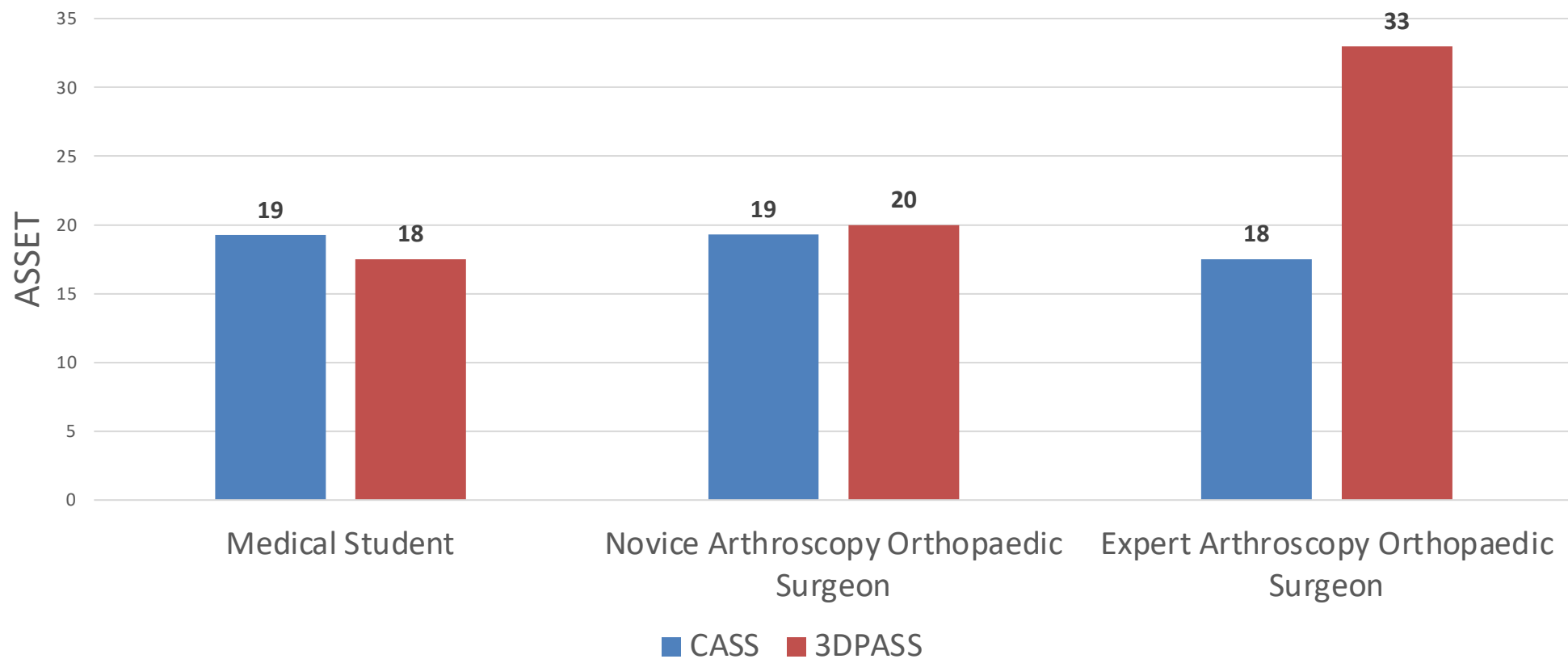
Results

- There was a moderate negative correlation between the number of shoulder arthroscopies previously performed and the time to task completion on both the CASS (r=-.46) and 3D-PASS (r=-.46).

- Among all participants, subjects improved on their anatomy test from a 55% to a 72% (p=.005) after performing the 4 tasks on the CASS and from 48% to 73 % on the 3D-PASS (p=.01).

Anatomy Test Score Before and After Shoulder Arthroscopic Simulator Usage for the Alex 3 and Novel Simulator
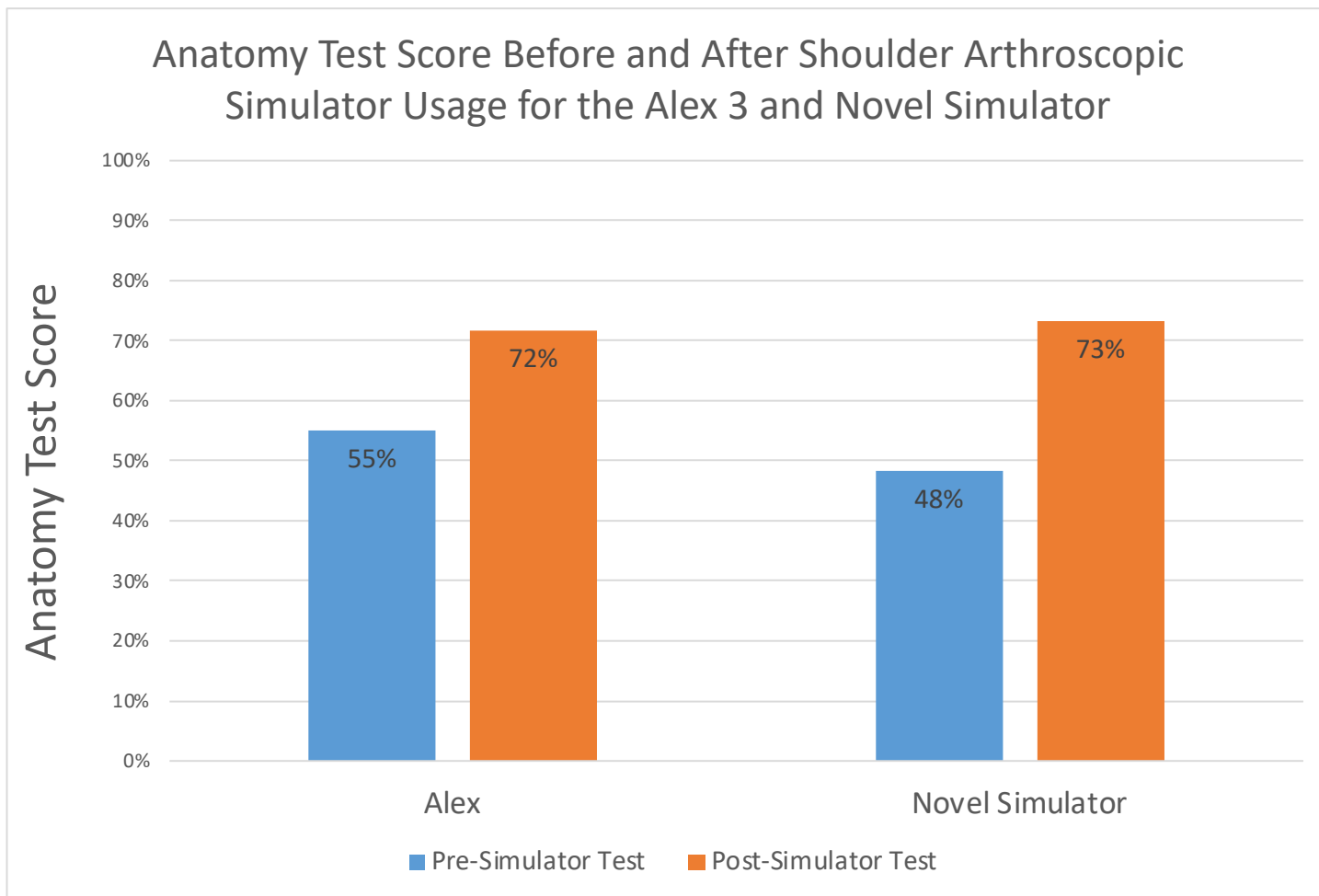
Conclusions

- The 3D printed arthroscopic shoulder simulator demonstrated construct validity with more experienced arthroscopy surgeons performing tasks faster and educational value comparable to a commercially available shoulder simulator.

- The 3D printed arthroscopic shoulder simulator demonstrated validity for both time and the ASSET

- The Commercially Available Simulator demonstrated construct validity with respect to time, but not ASSET

Significance

- The 3D printed arthroscopic shoulder simulator is valid as a training tool for surgical trainees

- Low cost – For the cost of a cigar box simulator you can instead have a fully functioning high fidelity simulator

- Can be deployed internationally to train worldwide
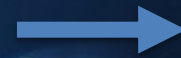
Thank you

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