Evaluation of Arthroscopic Shoulder Simulation Varies in Methodology, Quality, and Transferability: A Systematic Review of Impact on Trainee Performance

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Introduction

- Shoulder arthroscopy is a core competency for orthopedic surgery residents as defined by the American Academy of Orthopedic Surgeons (AAOS)
- Time surgical residents spend in the operating room has been reduced by duty hour restrictions set forth by the Accreditation Council for Graduate Medical Education (ACGME) and quality assurance initiatives that aim to increase operating room efficiency[1]
- Survey of 272 orthopedic surgery residents (24 programs) found that more ½ of PGY-5 felt there was not adequate time dedicated to arthroscopic training and did not feel as prepared in arthroscopy as compared to open techniques[2]
- Simulation meets the necessity to increase repetition and familiarity with arthroscopic procedures without the risks of the operating room[3]
- Simulator models in orthopedic surgery = bench-top, animal, cadaver, as well as both augmented and virtual reality[4]

Aims and Objectives

- The purpose of this systematic review was to assess the value of arthroscopic shoulder simulation amongst orthopaedic surgery trainees. It was hypothesized that participants exposed to arthroscopic simulation would have improved performance outcomes when reassessed on a simulator, cadaver, or patient.

Methods

- A literature search was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, using PubMed, Medline (Ovid), and EMBASE library databases (Figure 1)
- Search terms = “arthroscopic”, “shoulder”, and “simulation” OR “simulator”
- Participant demographics, type of simulator training, validity (transfer or construct) and performance outcome measures (i.e. Arthroscopic Surgical Skill Evaluation Tool (ASSET), time to completion) were systematically reviewed
- Inclusion Criteria: reported on arthroscopic simulation in the shoulder, assessed orthopaedic surgery trainees (residents, fellows, or medical students), utilized performance outcome metrics, reported these metric results from before and after simulator training (i.e. pre- and post-test results), published within the last 20 years and were published in English

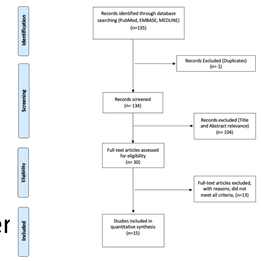

Figure 1. Preferred Reporting Items for Systemic Reviews and Meta-Analyses (PRISMA) guidelines for article inclusion

Results

- Fifteen studies met inclusion criteria with a total of 353 participants
- The most common procedures simulated were diagnostic shoulder arthroscopy (n = 9 [60%]), arthroscopic Bankart repairs (n = 3 [20%]), and rotator cuff repairs (n = 2 [13%]).
- Simulations primarily utilized virtual reality (60%) and bench top models (40%).
- The primary outcomes measured were time to task completion and ASSET scores.
- Time to task completion improved significantly with training (range 13-439 seconds pre-test to 8-253.29 seconds post-test), with substantial heterogeneity across studies (I2 = 87%).
- ASSET scores improved in 60% of the studies (ranging from 14-20.9 pre-test to 17.9-28.5 post-test), with low heterogeneity (I2 = 20%).
- Both camera and probe distances decreased after simulation use, while the 14-point anatomic checklist showed no pre to post-test differences.

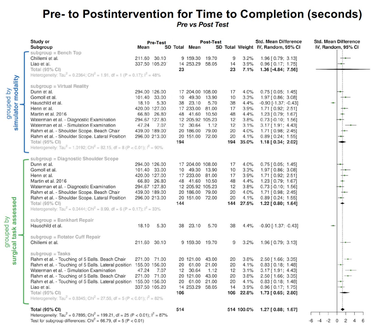

Figure 2. Forest plot of pre-to post-intervention for time to completion (seconds).

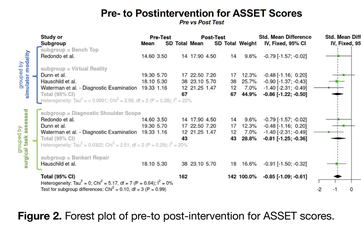

Figure 2. Forest plot of pre-to post-intervention for ASSET scores.

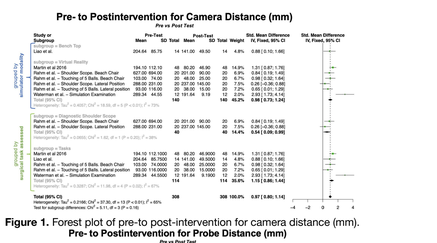

Figure 1. Forest plot of pre-to post-intervention for camera distance (mm).

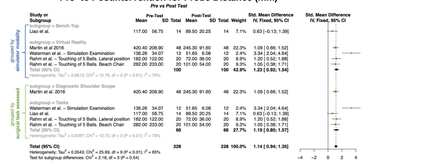

Figure 1. Forest plot of pre-to post-intervention for probe distance (mm).

Conclusions /Discussion

- Arthroscopic simulation training leads to an improvement in assessment of arthroscopic shoulder skills in orthopaedic trainees
- High heterogeneity in I^2 analyses suggests considerable variability influenced by factors like simulator design, study protocols, task complexity, and participant expertise
- Moreover, the quality, assessment, and validity of arthroscopic simulation protocols and studies varies.
- Translation of simulation training into the operating room remains to be conclusively demonstrated.

References

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