# Microsurgical Simulation Exercise for Surgical Training

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**OBJECTIVE:** Initial training for orthopedic surgical residents (postgraduate years 1-5) in microsurgery using the turkey wing model and evaluation of their proficiency.

**DESIGN:** Residents were given a questionnaire on their comfort level with microsurgery and microsurgical knowledge, followed by a lecture on the subject. They watched a surgical dissection and repair of the turkey wing's neurovasculature. Residents performed the dissection and repairs of the artery, vein, and nerve. A postquestionnaire was administered following the simulation exercise. Their performances on repairs were graded and results compared by academic year.

**SETTING AND PARTICIPANTS:** A total of 21 orthopedic surgery residents were recruited from Stony Brook University Medical Center, Stony Brook, NK.

**RESULTS:** This training activity resulted in significant improvements in both microsurgical knowledge (41%) and comfort (37%). Senior residents scored significantly higher than juniors on 6 microsurgical parameters. The largest effect was in nerve repair showing 4 parameters that differed significantly between groups.

**CONCLUSION:** Microsurgical techniques require extensive training to master. The turkey wing model for repair of the artery, vein, and nerve represents a realistic simulation of a human hand artery, vein, and nerve. It provides an inexpensive method for residents to practice on real tissue for improving microsurgical technique. (J Surg Ed 73:116-120. © 2015 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

**KEY WORDS:** microsurgery, training, laboratory model, neurovasculature skills

**COMPETENCIES:** Patient Care, Medical Knowledge

## INTRODUCTION

Extensive training is required to master microsurgical skills for repairing arteries, veins, and nerves. Orthopedic surgery residents must learn microsurgical techniques for the delicate handling of soft tissues for neurovascular repairs for traumatic injury. Hand Surgery Fellows require advanced skills to perform replants and reconstructive microsurgical procedures.

Surgical skills training requirements as of July 2014 (the Residency Review Committee for orthopedic surgery, of the Accreditation Council for Graduate Medical Education)[1] mandate basic surgical skills training for the postgraduate year 1 [PGY1] rotation curriculum that include soft tissue management, suturing, bone management, arthroscopy, fluoroscopy, and use of basic orthopedic equipment.

The training and development of technical proficiency for these fine motor skills occurs in laboratories with hands-on experience using animals or devices such as silastic tubing, gloves, models, umbilical cords, and cadavers.[2-19] Unfortunately, there is currently a lack of strong evidence supporting the superiority of any of these training methods.[20,21] A virtual simulator can create real-time simulation of microsurgical environments[22] but scheduling sessions for each resident individually becomes an issue, and there is no true tissue pliability in this exercise.

In the interests of cost and time, we modified the "infused chicken wing method" developed by Olabe and Olabe[23] providing a simple and realistic training method substituting a turkey wing for the chicken wing because the turkey wing has more consistent and appropriately sized neurovascular structures for introductory microsurgical training.[24] Moreover, there is good evidence that low fidelity models, such as this, are as effective as

The figures for this article were photos taken in the laboratory specifically for this study.

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high-fidelity models for microsurgical training and much more cost effective.[25]

## MATERIALS AND METHODS

A total of 21 residents completed a questionnaire on their comfort level with microsurgery and microsurgical knowledge, followed by a lecture. The comfort questionnaire was scaled from 1 (least comfortable) to 10 (extremely comfortable) focusing on the following: (1) grasping a needle under the microscope, (2) tying square knots under microscope, (3) cutting microsurgical sutures, (4) identifying artery, (5) identifying nerve, (6) identifying vein, (7) removing adventitia, (8) dilating artery, and (9) placing sutures. Each survey was on based on a 1-to-10 scale, 1 being uncomfortable and 10 being very comfortable.

The knowledge questionnaire consisted of diagrams depicting correct needle angle, correct distance, and correct placement of the first 2 sutures. Additional questions covered suture size, needle size, irrigation techniques, placement of the last 2 sutures, technique for suturing the vessel back wall, and microscope magnification. The questions were multiple choice.

Residents watched a surgical dissection and proper repair of a turkey wing's neurovasculature. The residents performed dissection and repairs to artery, vein, and nerve. Repairs were evaluated for approximation of vessel and nerve ends, back wall violation, proper approximation of vessel edges/mushrooming of nerve, suturing the epineurium only, appropriate suture placement and number, gaps in repair, and use of square knots. The evaluations were graded on a 1-to-10 scale for each subject matter. Each nerve and vessel was evaluated for the above characteristics, inspected using a microscope. The vessels were tested for flow and leakage using simulated arterial blood (Laerdal, Wappingers Falls, NY) so that errors would be evident. The evaluations were performed by a single-hand fellow who was blinded to the subjects who performed the repairs. Resident's results were compared by year in training and progress.

Following this microsurgical exercise, the comfort and knowledge questionnaire was repeated. The results of the pre- and postquestionnaires were compared to evaluate whether microsurgical knowledge or comfort was altered. The questionnaires were given after the resident completed the exercise. Approximately one-third of the residents completed the exercise immediately, one-third completed the exercise between 3 and 5 weeks after the initial demonstration, and one-third completed the exercise between 6 and 8 weeks afterwards.

## STATISTICS

The primary hypothesis tested if this training exercise positively affectted microsurgical knowledge and comfort, assessing differences between pre- and postquestionnaire results for all residents using paired samples $t$ tests. The secondary hypothesis tested if the more experienced residents (seniors—PGY4 and PGY5) would outperform less experienced residents (juniors—PGY1, PGY2, and PGY3). The group means were compared for the 8 specific microsurgical assessments and combined scores for each type of repair, and pre- and postquestionnaire results, using nonparametric independent-samples Mann-Whitney $U$ Tests. All analyses had an alpha level for significance of 0.05.

This study was institutional review board exempt for scope of laboratory training as it was a voluntary training exercise, all collected data were de-identified, and there was a minimal risk to the subjects.

## RESULTS

The results showed significant improvement in microsurgical knowledge by 41% and comfort by 37% (Table 1). Pre-to-postmicrosurgical knowledge questionnaire revealed increases for 81% of the residents, 14.3% performing worse, and 4.8% no change. The comfort results showed 81% of residents reporting improved comfort, 9.5% no change, and 9.5% lower levels of comfort.

Seniors scored higher than juniors on 7 of 8 microsurgical measures, with statistical significance achieved for 6 of 8 measures. Suture placement for artery anastomosis showed significance, with seniors outperforming juniors by 26% (Table 2).

For the vein anastomosis, back wall violation differed significantly, with seniors outperforming juniors by 27% (Table 2).

Nerve repair showed significant differences where seniors outperformed juniors by 30% for ends approximated, 22% for epineurium sutured, 28% for suture placement, and 16% for combined surgical score (Table 2).

Of note, there were no differences between the groups that completed the exercise immediately after the demonstration compared with those who completed it between 3 and 5 weeks or those who completed between 6 and 8 weeks afterwards.

**TABLE 1.** Test and Survey Results.

| | Knowledge | Comfort |
|---|---|---|
| Pretraining ($N = 21$) | | |
| Mean | 8.1 | 4.8 |
| SD | 1.5 | 1.9 |
| Posttraining ($N = 21$) | | |
| Mean | 11.4 | 6.6 |
| SD | 2.3 | 1.5 |
| p Value | 0.000 | 0.000 |

SD, standard deviation.