An Innovative Technique of Microsurgical Training on Fresh "Chicken Quarter" Model: Our Experience

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Abstract

Purpose Regular practice, quality clinical exposure, and academic discussion are essential in any surgical specialty training. This study discusses and validates the option of using a fresh "chicken quarter" model with a measurable scoring system, as a standard training regimen in microvascular surgery. This can be a very effective, economical, and easily accessible model for residents.

Materials and Methods This study was conducted in the Department of Plastic surgery, from October 2020 to May 2021. Twenty-four fresh "chicken quarter" specimens were dissected and the ischial arteries and femoral veins' external diameter (ED) were measured. The microsurgical skills of the trainee were assessed in 6 months intervals using the Objective Structured Assessment of Technical Skills Scale (OSATS) as well as the time taken for anastomosis. All the data were analyzed using SPSS (statistical package for social sciences) version 21.

Results A task-specific score value of 50% on October 2020 improved to 85.7% by May 2021. This was found to be statistically significant ($p = 0.043$). The mean ED of the ischial artery and femoral vein was 2.07 and 2.26 mm, respectively. The mean width of the vein measured at the lower one-third of the tibia was 2.08 mm. A greater than 50% reduction in anastomosis time was observed after a period of 6 months.

Conclusion In our minimal experience, the "chicken quarter model" with OSATS scoring system seems to be effective, economical, very affordable, and easily accessible microsurgery training model for the residents. Our study is done only as a pilot project due to limited resources and we have the plan to introduce it as a proper training method in the near future with more residents.

Keywords
- microvascular surgery
- anastomosis
- chicken quarter model
- OSATS
- COVID-19

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Introduction

Microsurgery involves the use of a surgical microscope or high-powered loupe magnification to facilitate the anastomosis of the small vessels and nerves. This specialty requires hand-microscope-eye coordination, respectful handling of the delicate tissues, and steady, fast, and fine surgical technique.[1] The margin of error is very small; hence, rigorous and sustained practice is essential for excellence. Unfortunately, the training avenues available for a micro-vascular trainee are very less. At the time of pandemic, increased prioritization of coronavirus disease 2019 (COVID-19) treatment leading to diversion of medical resources and manpower, fear of COVID-19 transmission, logistical challenges due to travel restrictions as well as economic slowdown furthers reduced the avenues for the microsurgery training.[2,3]

Various microsurgical models have been described for the teaching of microsurgical trainees. This includes silicon tubes, surgical gloves, gauze, tissues from human cadavers, placenta, chicken wings, chicken thighs, and even live animals like rats and rabbits.[4,5] To continue the microsurgical training of any enthusiastic resident, at the same time with parameters close to an actual model, we have explored the use and standardization of micro-vascular practice in fresh “chicken quarter” specimens with OSATS (Objective Structured Assessment of Technical Skills Scale) scoring system. In this study, we have shared our experience it as an effective, easily available, and economical microsurgery practice model for the residents.

Materials and Methods

This study was conducted by the plastic and reconstructive surgery unit (consist of one consultant and one resident) of a regional cancer center situated in Northeast India as a pilot project for a period of 6 months, from October 2020 to May 2021. We obtained fresh “chicken quarter” from the market (350 g) and used an isolated room in operation theater (OT) complex (where no surgeries were performed) for dissection, every Saturday from 10 AM to 12 PM. We used to shift the OT microscope to that spare room for each practice session. Before the start of the session, the diameters of the vessels were measured and 8–0 Ethilon (NW3708; ►**Fig. 1**), suture was used for the anastomosis during the session. After each training session, the whole OT complex was fumigated and practice set of instruments was properly washed and dried and sent for sterilization. As the study was done on dead chicken quarter model that we used to buy from nearby meat shop, review board approval was not taken. We had taken utmost care to maintain the sterility of the OT and at the same time the care was taken to dispose of the chicken quarter piece after the practice session.

Dissection

The chicken quarter piece was placed on the table and dissection was performed in the areolar plane between iliotibial and iliofibularis muscle (►**Fig. 2**) to expose the neurovascular pedicle. Partial excision of the muscles may be needed to completely expose the vessels. The microscope was adjusted at 5X magnification at a focal length of 25 cm.

Assessment

We have used modified task-specific score (TSS) of the OSATS at 6 months interval to assess the quality of the anastomosis (►**Table 1**) and the time taken for anastomosis (both the artery and the vein). The vernier caliper was used to measure the diameter of the femoral vessels before each anastomosis

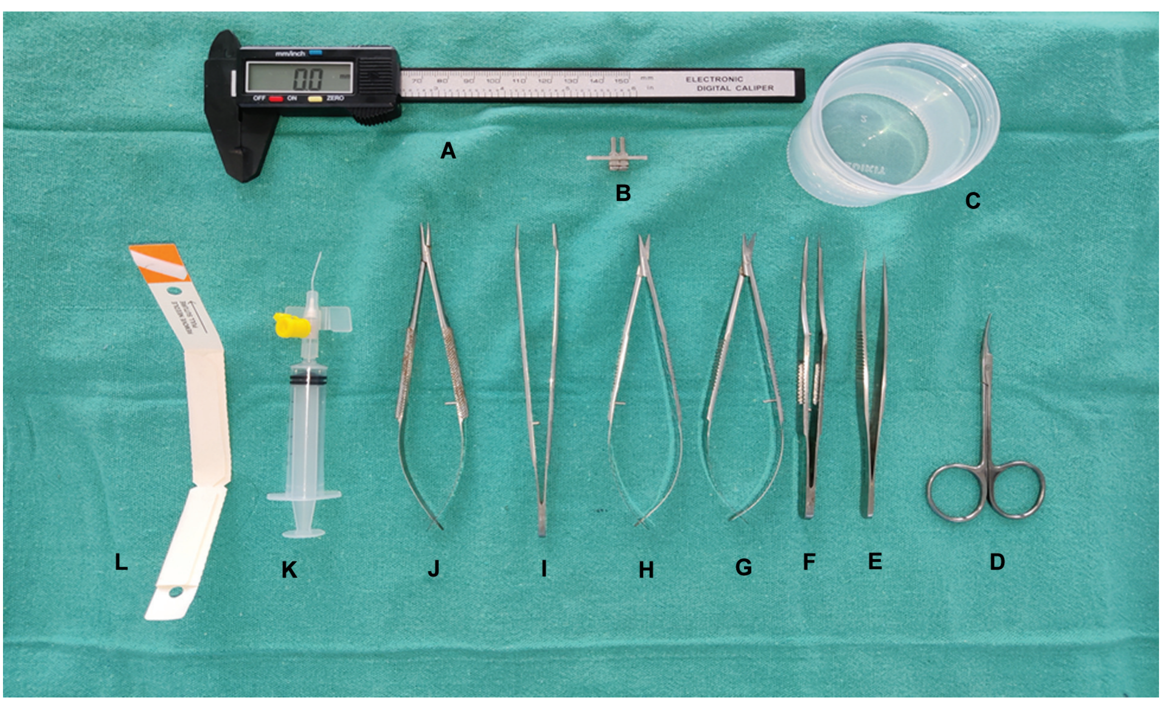

Fig. 1 (**A**) Vernier caliper, (**B**) vascular clamps, (**C**) saline, (**D**) dissecting scissors, (**E**) jewel forceps, (**F**) vessel dilator, (**G**) curved scissors, (**H**) straight scissors, (**I**) clamp applicator, (**J**)needle holder, (**K**) syringe with 23-gauge cannula, and (**L**) Ethilon 8–0.

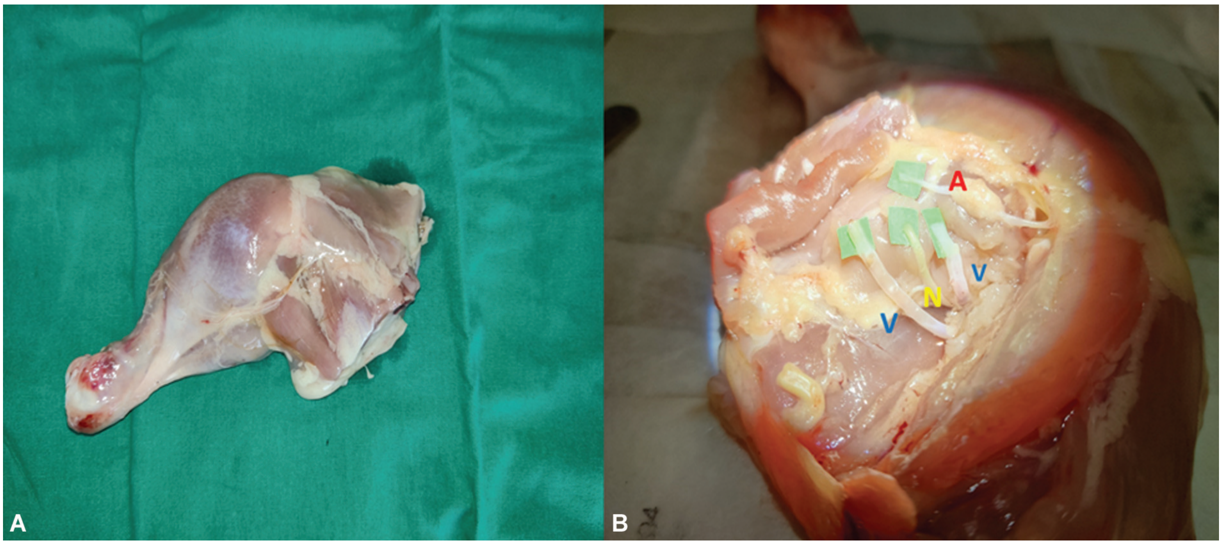

Fig. 2 (**A**) Chicken quarter piece and (**B**) vessels and nerve (A–artery, V—vein, N—nerve).

(►**Fig. 3**). The width of the ischial artery was measured at the mid-third of the femur while the femoral vein was measured at the mid-third of the femur and lower one-third of the tibia.

Statistics and Results

►**Table 1** shows the OSATS score of the trainee in October 2020 (7/14) and May 2021 (12/14). An improvement can be seen in most of the critical steps except appropriate depth of tissue bite on each side and efficient handling of suture while tying the knot. Using the IOWA scale for microvascular assessment, the scores are assessed using the TSS. Descriptive statistics was used followed by a chi-squared test to evaluate the association of scores (0 and 1) between two-time points. A p-value less than 0.05 was considered significant at a 95% level of significance. It is observed that in October 2020, a TSS value of 50% on October 2020 improved to 85.7% by May 2021(►**Fig. 4**) and this was found to be

Table 1 Microvascular Objective Structured Assessment of Technical Skills (OSATS)-task-specific score

Passing needle through tissue*		
	October 2020	May 2021
	Correct	Correct
1. Loads needle in drive ½ to ⅔ from needle tip	1	1
2. Needle does not wobble in driver	0	1
3. Needle enters tissue perpendicularly	1	1
4. Forceps handle vessel adventitia to provide counter traction	0	1
5. Dilator is appropriately used	1	1
6. Needle is pulled through tissue following its curve	1	1
7. Suture is pulled out parallel to the tissue	1	1
8. Suture tails are left at the correct length	0	1
9. Appropriate depth of tissue bite on each side	0	0
10. Sutures are spaced appropriately	0	1
Knot tying		
11. Three or more square throws are tied	1	1
12. Efficient handling of suture while tying	0	0
13. Appropriate tension on suture while tying	0	1
14. Tissue well-approximated but not strangulated	1	1
Total score	7/14	12/14

Note: The OSATS score of the trainee in October 2020 (7/14) and May 2021 (12/14). An improvement can be seen in most of the critical steps except appropriate depth of tissue bite on each side and efficient handling of suture while tying the knot.
*Tasks are given a score of 1, only if done correctly more than 75% of the time.

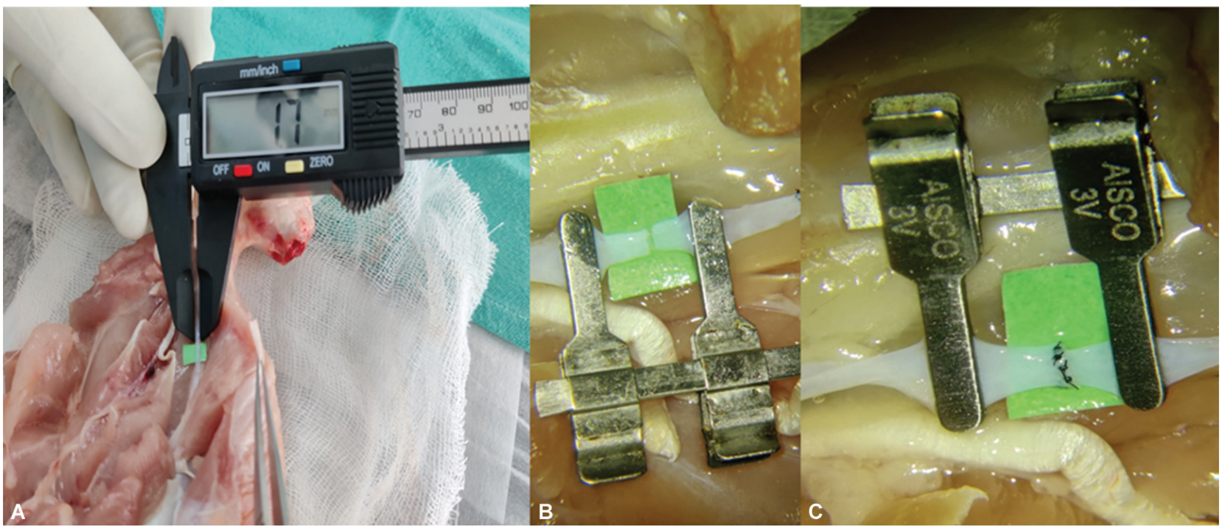

Fig. 3 (A) Measuring external diameter with vernier caliper, (B) preanastomosis, and (C) after anastomosis.

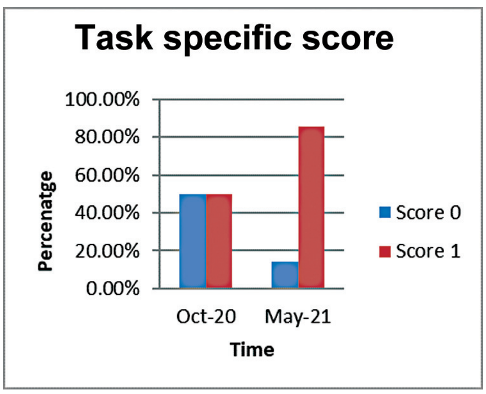

Fig. 4 Its observed that in October 2020, an Objective Structured Assessment of Technical Skills Scale-task-specific score value of 50% on October 2020 improved to 85.7% by May 2021. This was found to be statistically significant ($p = 0.043$).

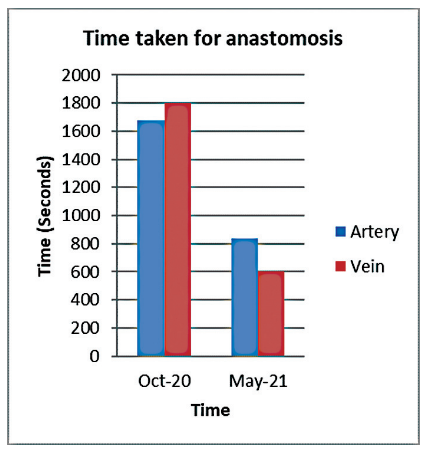

Fig. 5 Graphical representation of the time taken for anastomosis.

statistically significant ($p = 0.043$). Significant reduction in anastomosis time can be seen (>50%) at the two different time intervals (►**Fig. 5**). The mean ED of the ischial artery and femoral vein was 2.07 ± 0.11 and 2.26 ± 0.16 mm, respectively. The mean width of the vein measured at the lower one-third of the tibia was 2.08 ± 0.18 mm (►**Fig. 6**).

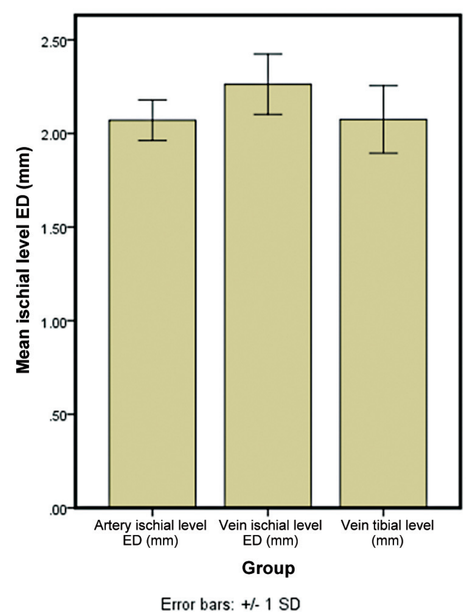

Fig. 6 Graphical representation of mean width of vessels at ischial and tibial levels.

Discussion

In an attempt to find a suitable method for microvascular training for the residents, we made an effort to standardize as well as objectively and subjectively assess the skills of the resident while training on a chicken thigh model. The OSATS scoring system was used in this study that was first described by Reznick et al. This scale relies on set criteria for scoring of surgical skills that maximizes validity and minimizes inter-examiner bias.[6]

The variables used in the above TSS include those crucial steps that can affect the outcome of the anastomosis. The scoring was done by the plastic surgeon and the trainee was a maxillofacial surgeon who had received a brief exposure to

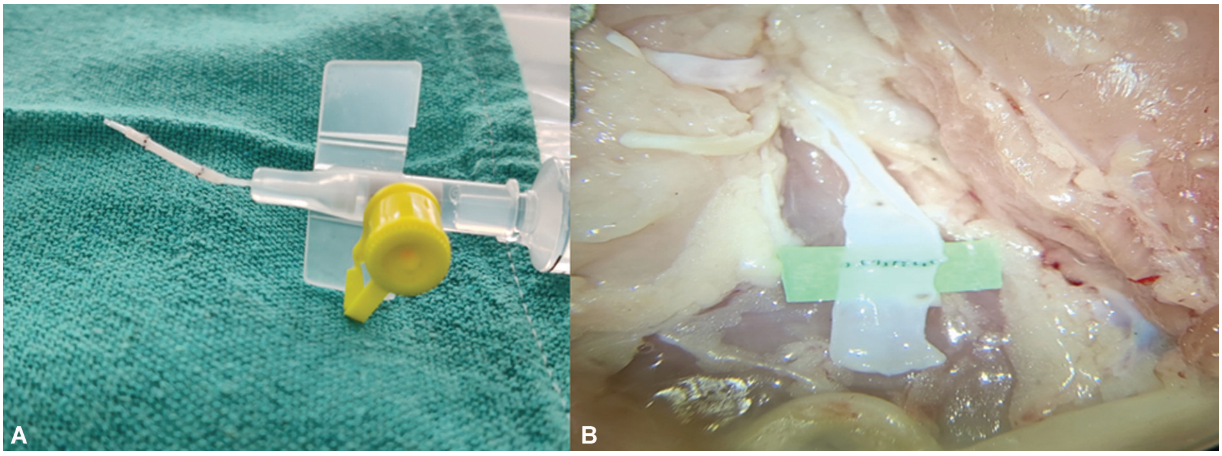

Fig. 7 (**A**) Checking anastomosis patency using a 23 G cannula and, (**B**) sectioning of the vessel.

microvascular surgery during his residency in head and neck oncology. A significant improvement in TSS is observed between the time intervals ($p = 0.043$). It is observed that 50% (7 out of 14) with a score of 1 at the beginning of the study (October 2020) improved to 85.7% after a gap of 6 months (May 2021). The critical aspect for performance improvement is identifying areas that need improvement and engaging in effective training. This "deliberate practice" requires that the performer "be fully prepared for the initiation of the task, be given immediate feedback from the outcome, and then be allowed to repeat the similar task with gradual and systematic modifications."[7] In our study, once the trainee completed the anastomosis the vessel was sectioned and a 23 G cannula was passed through the vessel. A smooth passage ensured no back-wall suturing. Further, the vessels were sectioned and the intimal aspect was assessed to see the uniformity of the suture bites (►**Fig. 7**).

The time taken for anastomosis by the resident in October 2020 was 1,680 seconds for an artery, while 1,800 seconds were taken for a vein. On assessment after 6 months, the time taken reduced to 840 and 600 seconds, respectively. Jeong et al in 2013 performed a study to assess the effectiveness of fresh chicken thighs as a training model. The study included three trainees and a statistical reduction in their procedure time was noted with an increase in the trial number.[8]

During the 6 months of study, the vessel diameters were assessed for both artery and vein at different levels of dissection. The mean ED of the ischial artery and femoral vein was 2.07 and 2.26 mm, respectively. The mean width of the vein measured at the lower one-third of the tibia was 2.08 mm. In 2016, Kang et al anatomically evaluated the chicken vessels as an anastomosis training model. Twenty-six chickens were studied and the external diameter of the vessels in ascending order is as follows, ischiatic vein (2.69 ± 0.33), basilic vein ((1.88 ± 0.36 mm), ischiatic artery (1.68 ± 0.24 mm), common dorsal metatarsal artery (1.23 ± 0.23 mm), cranial tibial artery (1.18 ± 0.19 mm), brachial artery (1.08 ± 0.15 mm), ulnar artery (0.82 ± 0.13 mm), and radial artery (0.56 ± 0.12 mm).[9] In humans, the average diameter of the radial artery,[10] descending branch of the lateral circumflex femoral artery,[11] and peroneal artery[12] is 2.5, more than 2 mm, and 1.8 to 2.5 mm, respectively. These are the vessels on which the most common flaps are based in head and neck reconstruction. Human digital arteries are reported to range from 0.80 to 1.37 mm.[13] This is in close relation to the diameter as observed by Kang et al in the metatarsal and brachial vessels of chicken.[9] Given the vessels of varied diameter available in a chicken model, the trainee can assess and choose respective vessels for dissection and anastomosis accordingly.

We have made an effort to validate and standardize the use of fresh chicken quarter as a routine training model for microvascular trainees in their curriculum. A similar viewpoint was made by Creighton et al, who performed a validation study amongst thirteen residents. Their anastomosis exercises were video-recorded and the time required for trainees to complete the first stitch of their first anastomosis as compared with the time required for the first stitch of their last anastomosis. There was a statistically significant decrease between the time required for the first stitch (235 seconds 95% confidence interval [CI]: 198 to 272 seconds compared with the last stitch (120 seconds 95% CI: 92–149 seconds, and an average 48.7% (115 seconds) decrease in time ($p < 0.001$).[14] A study done by Chen et al studied the ischiatic neurovascular bundle and its branching pattern in the chicken thigh and suggested the use of vessels in the range of 0.3 to 0.8 mm as a training model in super-microsurgery.[15]

There are earlier studies that explored the use of fresh chicken legs as an experimental model for anastomosis training.[8,16] In our observation, we noticed that in a "chicken quarter" there is an intact neurovascular bundle from the ischial foramen and helps to maintain the vessels on stretch during anastomosis. A similar observation is made by Erman and Deschler in a study done at Harvard Medical School, Boston.[17]

The OSATS used in our study is remarkable not only in identifying a specific area of deficit in a trainee as well as immediate feedback but also has high inter-rater reliability. Nimmons et al[18] performed an exhaustive study to validate the TSS system in microvascular surgery. Twenty surgical staffs performed microvascular anastomosis of a chicken ischiatic artery. Analysis of variance revealed a significant effect of training and microvascular experience for both the TSS and global rating scale score ($p < 0.005$) Though our study includes a single expert and one trainee, we have made an earnest attempt to standardize our training environment and parameters. It is done as a pilot project with a single trainee and we have plan to introduce it as a proper training method in the near future.

All the recognized microvascular training centers in the India use live chicken or rats. We did not use live models as it needs animal laboratory, proper license to carry out such training and it is costly. Our model is efficient and cost-effective as it costs only 30 to 40 rupees for a chicken quarter piece. Cost-effectiveness of the procedure will be the same as one chicken quarter piece can be used by more than one trainee. One drawback of our chicken quarter model is that we could not assess the flow of the blood through the anastomosis that could be compensated by pushing dye through the anastomosis and assessing the patency. Few other limitations of our study are as follows:

1) The OSATS score does not have any component like the number of the sutures, but we are in the opinion that more the number of the sutures, more will be the time taken for the anastomosis, we will consider this in our next elaborated project.
2) It is a good idea to consider OSATS score at the end of 3 months to see the end-point of the skill laboratory training with regard to the months from the beginning where one can find a plateau in OSATS score and time for anastomosis.

This is a pilot project only; we will assess the OSATS score also in the 9th and the 12th months that might give and indirect indicator of the ability or safety of a trainee to perform clinical cases independently.

Conclusion

In our very limited experience, we have found that the “chicken quarter” model with OSATS scoring system is a very effective, economical, and easily accessible method for residents to learn microvascular surgery. Our study is done as a pilot project and in future we will incorporate greater number of residents with more elaborate planning.

Conflict of Interest
None declared.

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