

MICROSURGICAL TRAINING: THE ITALIAN EXPERIENCE

P. Tos, A. Fin, A. Crosio, R. Baraziol, I. Marcoccio, A. Antonini,
 N. Felici, M. Pignatti, S. D'arpa, Z. Arnez, F. Moschella

Education Committee Italian Society for Microsurgery, Italy

The Italian Society for Microsurgery (SIM, Società Italiana di Microchirurgia) developed a 5 steps training program for surgeons from different specialties who want to learn microsurgery as part of their practice. This 5 steps program has been established in 2013 and each course has a unique program and its own logo.

Presently, there are 10 basic courses in Italy recognized by the SIM in Italy. The basic courses have a theoretical part and a practice of at least 20 hours each, performed on an *ex-vivo* model. There are minimum requirements for each step must be competed to be able to move to the consequent exercise. At the end of the course, each student is evaluated following an extract of the GRS score.

The advanced course is exclusive, it opens to only 20 students each year and involve 35 self-funded tutors.

The program stated by the Italian Society for Microsurgery is very comprehensive and gives the opportunity to young surgeons to learn many aspects of the microsurgical reconstruction.

Keywords: *Microsurgical training, training program, steps of the Italian program.*

Conflict of interest: the authors declare the absence of obvious and potential conflicts of interest related to the publication of this paper.

Financial disclosure: no author has a financial or property interest in any material or method metioned.

For citation: Tos P., Fin A., Crosio A., Baraziol R., Marcoccio I., Antonini A., Felici N., Pignatti M., D'arpa S., Arnez Z., Moschella F. Microsurgical training: the Italian experience. *Issues of Reconstructive and Plastic Surgery*. 2021;24(1):103–108.
 doi: 10.52581/1814-1471/76/13

МИКРОХИРУРГИЧЕСКОЕ ОБУЧЕНИЕ: ИТАЛЬЯНСКИЙ ОПЫТ

П. Тос, А. Фин, А. Кросио, Р. Барациол, И. Маркоччио, А. Антонини,
 Н. Феличи, М. Пигнатти, С. Д'арпа, З. Арнез, Ф. Москелла

Комитет по образованию Итальянского общества микрохирургии, Италия

В 2013 г. Итальянское общество микрохирургии (ИОМ, Società Italiana di Microchirurgia) разработало программу обучения в 5 этапов для хирургов разных специальностей, которые хотят изучать микрохирургию в рамках своей практики. Каждый курс имеет уникальную программу и свой логотип.

В настоящее время в Италии действуют 10 базовых курсов, признанных ИОМ. Базовые курсы имеют теоретическую и практическую части продолжительностью не менее 20 ч каждая. Обучение проходит на модели *ex-vivo*. Существуют минимальные требования к каждому этапу. Переход к последующему этапу возможен только при условии прохождения предыдущего этапа. В конце курса каждый студент оценивается по выписке из GRS.

Продвинутый курс является эксклюзивным, набор составляет 20 студентов год.

Программа, заявленная ИОМ, является всеобъемлющей и дает возможность молодым хирургам изучить многие аспекты микрохирургической реконструкции.

Ключевые слова: *микрохирургическое обучение, программа обучения, этапы итальянской программы.*

Конфликт интересов: авторы подтверждают отсутствие конфликта интересов, о котором необходимо сообщить.

Прозрачность финансовой деятельности: никто из авторов не имеет финансовой заинтересованности в представленных материалах или методах.

Для цитирования:

Тос П., Финн А., Кросио А., Барацциол Р., Маркоччио И., Антонини А., Феличи Н., Пигнатти М., Д'арпа С., Арнез З., Москелла Ф. Микрохирургическое обучение: итальянский опыт. *Вопросы реконструктивной и пластической хирургии*. 2021;24(1):103–108. doi: 10.52581/1814-1471/76/13

INTRODUCTION

The Italian Society for Microsurgery (SIM, Società Italiana di Microchirurgia) was established 10 years ago. SIM developed a five steps training program for surgeons from different specialties who want to learn microsurgery as part of their practice.

There are basic and more advance steps. In basic steps students learn the approach to the microscope and microsurgical sutures performed mostly on synthetic material and nonliving animal model. In more advanced steps students perform the dissection courses on cadaver, the flap raising courses on living animal model and finally, for more motivated students, the clinical fellowship.

This five steps program has been established in 2013 and each course has a unique program and its own logo (Fig. 1).

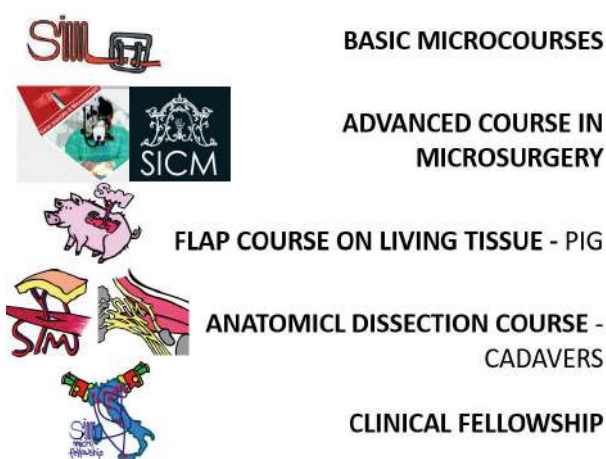


Fig 1. The different steps of the Italian program

Рис. 1. Различные этапы итальянской программы

BASIC COURSES

Presently, there are 10 basic courses in Italy recognized by the SIM in Italy.

Six of those courses were used to standardize the training path and help with accreditation the rest of the courses in different locations.

It is the belief of the SIM training committee that working on living models must be tackled after sufficient practice of the microsurgery techniques and getting sufficient expertise on non-living models to minimize the impact on the animal (complying with 3Rs).

Almost all the basic courses have a theoretical part and a practice of at least 20 hours each, performed on an *ex-vivo* model [1]. These skills are

reached after at least 40 hours of practice, at some courses up to 80 hours before the starting the advanced course.

Some training centers that have availability to work with live animal models for the basic course, have the requirements of only 10 hr of practice on *ex-vivo* models prior moving to living ones for another 10 hrs, which are maintained equal to 20 hrs of the courses on *ex vivo* model.

Based on IMSS consensus of 2020 [2] each student has the same equipment: a jeweler's forceps, a micro scissors; a microsurgical clamp, micro needle holder, and 8/0–9/0 sutures.

There is 1 tutor for every 3 students.

The principles of teaching and evaluation of the course are derived from Acland principles and based on the 6 points of the GRS score devised by the Queen Mary University Hospital (Table 1) [3–5]. In their turn they are subdivided in 20 points that the student must consider during the exercise, and on which he will be evaluated.

Courses structure**Macro skills**

Before going to the microscope there is a "macro" exercise where the student uses, without magnification, the microsurgical instruments and learns how to do the square/flat knot, how to manage the needle and suture and how to pass the needle under the direct vision of the tutor, which can correct any technical errors.

Micro skills

Then, we pass to the microscope: concepts of optics and setting up the microscope (initial single vision, then binocular focus, maximum magnification, the eyes are always on the operating field, etc) before starting sutures.

These are first work with the micro instruments on the gauze, then on practice card (Fig. 2), finally on the 3D model of the silicone tube. After the 2–3 sutures performed correctly on silicone tube students move to the chicken leg. The model of the silicone tube allows to practice in the positioning of the approximator and in the techniques of affixing points (polar, triangulated).

There are minimum requirements for each step must be competed to be able to move to the consequent exercise.

The chicken tight is known to be an excellent exercise model both for the size of the structures and for the similarity between the tissues of the model and the human ones [1].

Table 1. Queen Mary Global Rating Score to teach and evaluate the students [3]

Таблица 1. Глобальный рейтинг Queen Mary для обучения и оценки знаний студентов [3]

Queen Mary University London Microsurgery Global Rating Scale QMUL Micro GRS

Name/ID:		Setting			Clinical/Experiential Institution:	Model		Simulation Rat Other (Specify)	
	Component	Procedure	Error List (please score '0' if there are any of the following errors observed during the procedure)	1		3		5	Score
Preparation of operative field	S1	Preparation of operative field	Proceeds despite that operative field not ready for procedure, obstructed or blurred view with no background	loss of central view, inappropriately placed background		Op field prepared for procedure, uses background but fails to re-organize operative field through procedure (eg do not clear out pieces of suture)		continuous organization and optimization of operative field	
Dexterity / Instrument Handling	S2	Instrument holding and hand tremor	Persistent Tremor	Correct use of instruments, but frequent tremor		Correct holding of instruments but unsteady hands with occasional tremor		Correct and steady holding of instruments with No tremor	
	S3	Number of attempts to pick up the needle	Chases needle in field and unable to pick up needle after > 5 attempts	5 attempts		2 - 4 attempts		1st attempt	
	S4	Technique to pick up and mount needle	picks needle up with fingers OR handles needle with two instruments at the same time	Chases needle in field attempting to pick it up directly or takes >5 attempts to pick and mount needle		Manages to pick up the needle from suture and mounts it in dominant hand instrument in 2-5 attempts		Picks needle up indirectly with suture using non dominant hand then mounts it in the dominant hand instrument in 1 attempt	
	S5	Needle to Needle holder angle (Vertical Plane)	incorrect positioning of needle with needle pointing downwards to line of intended travel	Unable to position needle correctly (Too close to either tip or tail), or in correct position in >5 attempts		Positions needle correctly in 2 - 4 attempts OR needle pointing upwards to line of intended travel		Position needle in middle third in 1st attempt with needle pointing horizontally in line of intended travel	
	S6	Needle to Needle holder angle (Horizontal plane)	Unable to position needle correctly or in >5 attempts (angle too acute or too obtuse)	positions needle correctly after 5 attempts		Positions needle correctly in 2 - 4 attempts		Needle lies comfortably at right angles to the jaw of the needle holders in 1 attempt.	
	Needle Handling	S7	Angle of needle to tissue	Unable to maintain angle, drops needle or pushes abruptly through vessel wall	Frequently too acute or too flat		Occasionally too acute or too flat		Always passes needle perpendicularly through the vessel wall
S8		Driving needle through vessel wall	Attempts carried out without use of counter pressure	5 or more attempts / occasional use of counter pressure		2- 4 attempts / appropriate use of counter pressure		1st attempt with appropriate use of counter pressure	
S9		Guiding needle through vessel wall	Cuts through vessel wall	Pulls need through in a straight line not following curvature OR pulls suture perpendicularly upwards		Follows needle curvature BUT pulls suture through without use of pulley/counter pressure		Follows needle curvature AND pulls suture parallel to vessel wall while using the other hand instrument as a pulley/counter pressure	
S10		Needle damage	Breaks tip or needle	Grasps needle tip		needle bent or flattened		No damage AND no grasp of needle tip	
Tissue Handling	S11	Handling of Vessel	Tears vessel wall during suturing or stripping adventitia*	Attempts to handle tissue with care BUT grasps vessel edges		Fails to clear adventitia OR strip adventitia beyond 3x needle thickness		Does not grasp vessel edge at all, only handle edge from lumen, stay stitch or vessel adventitia	
	S12	Tissue bite	Vessel distortion as a result of unequal tissue bites on opposing edges AND between knots	Unequal tissue bites on opposing edges AND between knots without vessel distortion		Occasionally takes too wide or too small a bite on opposing edges OR unequal spaces between knots		Perfect bites: 2 - 3 times of the needle thickness on both opposing edges WITH even spaces between knots	
Suture Handling	S13	Suture damage	Breaks suture	Bent suture		Thinned points or spiraling of suture ends		No damage	
	S14	Make a loop in 4 steps: "Pick, loop, pick, tighten"	Does not clear field of access suture loops, recurrent slipping of loop off tip of instrument	Loop or free edge are too long OR too short for optimum knot tying OR entangled and struggling with surface tension		Starts from a prepared field with optimum suture position but fails to make a loop in 4 slick moves		Clear field, optimum position, successful loop in 4 slick moves.	
	S15	Knots tension and squaring	NEVER squares knots	Frequently Does not square knots OR knots too loose or too tight		Squares knots BUT pulls upwards perpendicular to vessel direction		All knots squared, pulls suture flat in perfect tension with approximated edges	
operative Flow	S16	Use of magnification	Does not use different magnification	Occasionally uses different magnification		Uses variable magnification inconsistently OR tends to persevere in one magnification power for both needle insertion and knot tying		Always uses higher magnification for needle and tissue handling and lower magnification to handle suture and make knots	
	S17	Operative Flow	Unable to complete task OR has long pauses between steps with hesitant movements OR no check for back wall catching	Completes procedure but very slowly		Does not stop AND checks for back wall catching BUT proceed in either rushed steps or slower than ideal pace		Does not stop, clearly familiar with steps AND always check of back wall catching	
	S18	Time Taken for anastomosis (up to 10 stitches)	>60 min	40-60 mins		21 - 38 min		≤ 20 min	
Quality of end product	S19	*Quality of anastomosis	Unacceptable: sutures are too loose, coming apart OR obvious tears and tissue damage OR significant vessel distortion	Poor: Unevenly spaced untidy stitches but no vessel distortion		Acceptable: stitches are spaced evenly BUT are untidy (out edges are not parallel to vessel or stick through lumen)		Superior: stitches are equally spaced with ends cut flat and at appropriate length, vessel edges perfectly opposed with no distortion	
	S20	Patency	Not patent OR catches back wall OR Clots*					Patent	
	** the marks for S10 is dependent on S20. If the vessel is not patent, both S19 and S20 will be automatically '0'								
	* Biological models								
	Total Score								

Fig. 2. Practical card – adapted from Jesus Usón Minimally Invasive Surgery Centre (JUMISC) in Caceres – Spain

Рис. 2. Практическая карта, адаптированная Центром мини-инвазивной хирургии им. Хесуса Усона (JUMISC) (г. Касерес, Испания)



The students learn to recognize the structures, to handle the vessels and their different layers. End-to-end and end-to-side anastomoses, neurorhaphy, vascular grafts can be performed. If the pupils succeed quickly, they can practice on the smaller vessels using the chicken wings. This phase lasts about 10–12 hours. At this point, the transition to the living model is allowed at the courses that use live models.

At the end of the course, each student is evaluated following an extract of the GRS score (Table 2). To assess the quality of anastomosis on an *ex vivo* model, the flow generated with a colored physiological solution and the suture quality using the ALI (Anastomosis Lapse Index) score [6] (Fig. 3) shall be considered.

Table 2. Short GRS to evaluate exercises at the end of the course – the 6th point (patency) in nonliving models is substituted by the ALI score (Fig. 3)

Таблица 2. Краткая оценка GRS для упражнений в конце курса – 6-й балл (проходимость) в неживых моделях заменяется баллом ALI (рис. 3).

	1	2	3	4	5
Time & motion	Many unnecessary moves		Efficient time/motion, but some unnecessary moves		Economy of movement and maximum efficiency
Instrument handling	Repeatedly makes tentative or awkward moves with instruments through inappropriate use		Competent use of instruments but occasionally appeared stiff or awkward		Fluid movement with instruments
Suture handling	Frequently damaged, broke or lost sutures		Occasionally damaged, broke or lost sutures		Sutures were consistently handled delicately under the control of operator
Tissue handling	Frequently used unnecessary force on tissue, caused damage inappropriate use of instruments		Careful handling of tissue, but occasionally caused inadvertent damage		Consistently handled tissue appropriately with minimal damage
Technical skill (anastomosis)	Poorly placed sutures and poor use of irrigation		Fair placement of suture and use of inappropriate use of irrigation		Well-placed sutures and appropriate use of irrigation
Flow of operation	Frequently stopped operating and seemed unsure of the next move		Demonstrated some forward planning, with reasonable progression of procedure		Obviously planned course of operation with effortless flow from one move to the next
Outcome (Patency)	Poor		Moderate, reduced flow		Excellent. Unimpeded flow

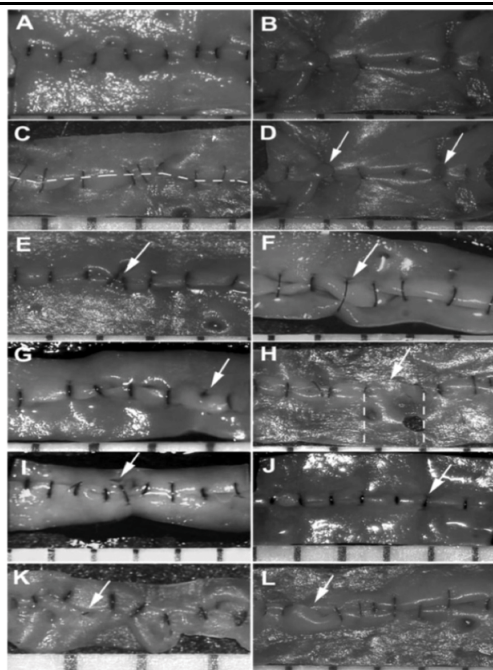


Fig. 3. The ALI (Anastomosis Lapse Index) score (A) Image demonstrating an error free anastomosis. (B) An anastomosis with multiple errors, (C–L) different errors frequently seen among students

Рис. 3. Показатель ALI (индекс разрыва анастомоза). А – изображение демонстрирует безошибочный анастомоз; В – анастомоз с множественными ошибками; С–L – различные ошибки, часто встречающиеся у студентов

ADVANCED COURSE

The advanced course is exclusive, it opens to only 20 students each year and involve 35 self-funded tutors (Fig. 4). It entails performing 16 different exercises during 120 hours of practice on the rats. These are preceded by theoretical lessons where videos of technique are shown, or tutors give the lectures about their experience in such procedures. In addition, students are advised to study the manual of Microsur-

gery available in free access on the website of the SIM before participating in the course (Fig. 5). This manual was created from the efforts of several tutors and teachers of the various courses. The program is divided into 3 weeks distributed over a calendar year.

Majority of students come from those three macro-areas of most frequent application of microsurgery techniques: hand surgery; head and neck reconstruction; reconstructive breast surgery.

The tutor-students ratio is 1:3/1:4.



Fig. 4. Advanced Course – Naples

Рис. 4. Продвинутый курс (Неаполь)



Fig. 5. The textbook of the Italian Society for Microsurgery for basic and advanced course: a text with progression and exercises has been written by all Italian teachers and tutors in 2015

Рис. 5. Учебник Итальянского общества микрохирургии для базового и продвинутого курса: текст с прогрессией и упражнениями был написан итальянскими преподавателями и наставниками в 2015 г.

Evaluation and Assessments

The student is asked and advised to write down a series of parameters on a self-evaluation sheet that includes annotations regarding technique (dis-

section time and anastomosis, patency, etc.), physical state, use of tools. The tutor has at his disposal a daily evaluation sheet, which allows him to follow the progress of his students.

Diploma

At the end of the course, to obtain the diploma, in addition to the practical test the student will have to take a written exam on the topics of the macro-area chosen and the discussion of a thesis on their own clinical experience.

The practical test involves the execution of 2 exercises in 5 hours. Within the final evaluation are awarded up to 20/80 points for the path taken by the student, considering its progression.

DISSECTION AND FLAP RAISING COURSES ON CADAVERS

Two courses are present in the program.

The *dissection course on perforator flaps* on cadavers takes place for 3 days every year in Nice and covers in its program the most frequently used free tissue flaps. It also provides a part of free dissection where the student can, for example, dissect the receiving vessels of the main anatomical areas. 2 students per one cadaver, and the tutors are in 1:4 ratio.

The *nerve course* is organized every 2 years and is held in Alicante (Spain). Is an International Course and covers all nerve pathology and palliative surgery of limbs; 2 participants per cadaver and an international faculty is present.

DISSECTION COURSE ON LIVE ANIMAL

The dissection course on perforator flaps utilizing the live animal model (pig) has the duration of two days. The dissection is limited, of course, to the flaps that can be reproduced on the animal model.

There is one pig per every 2 students available.

CLINICAL FELLOWSHIP

Every year the 2 most eligible students accepted to the microsurgery fellowship. This includes the attendance all the activities of 5 training centers of his choice for 2 weeks each to observe the different clinical applications of microsurgery. The fellowship must be completed within 2 years. Each fellow has a bourse of 2000 € to spent during the fellowship.

CONCLUSION

We think that the program stated by the Italian Society for Microsurgery is very comprehensive and gives the opportunity to young surgeons to learn many aspects of the microsurgical reconstruction. We are proud of our teaching program that we think is "unique" compared to other nations.

This accomplishment has been made possible by the determination of many Presidents of our Society and by the passion of all tutors around the country: plastic, orthopedic and head and neck surgeons.

REFERENCES

1. Hii-Sun Jeong, Min-Seon Moon, Hyoung-Suk Kim, Hye-Kyung Lee, Sang-Yeop Yi. Microsurgical training with fresh chicken legs. *Ann Plast Surg*. 2013;70(1):57-61.
2. Ghanem M. Kearns and A. Ballestín et al. International Microsurgery Simulation Society (IMSS) consensus statement on the minimum standards for a basic microsurgery course, requirements for a microsurgical anastomosis global rating scale and minimum thresholds for training, *Injury*. 2020;51 Suppl 4:S126-S130.
3. Applebaum M.A., Doren E.L., Ghanem A.M., Myers S.R., Harrington M., Smith D.J. Microsurgery Competency During Plastic Surgery Residency: an Objective Skills Assessment of an Integrated Residency Training Program. *Eplasty*. 2018 Sep 25;18:e25.
4. Leung C.C., Ghanem A.M., Tos P., Ionac M., Froschauer S., Myers S.R. Towards a global understanding and standardisation of education and training in microsurgery. *Arch Plast Surg*. 2013 Jul;40(4):304-11. doi: 10.5999/aps.2013.40.4.304. Epub 2013 Jul 17.
5. Myers S.R., Froschauer S., Akelina Y., Tos P., Kim J.T., Ghanem A.M. Microsurgery training for the twenty-first century. *Arch Plast Surg*. 2013 Jul;40(4):302-3. doi: 10.5999/aps.2013.40.4.302. Epub 2013 Jul 17.
6. Ghanem A.M., Al Omran Y., Shatta B., Kim E., Myers S. Anastomosis Lapse Index (ALI): A Validated End Product Assessment Tool for Simulation Microsurgery Training. *J Reconstr Microsurg*. 2016;32(3):233-41.
7. Pignatti M., Tos P., Garusi C., Schonauer F., Cherubino M., Tiengo C., Ciclamini D., Cozzolino S., Di Maro E., Jiga L.P., Ionac M., Nistor A., Georgescu A.V., Pinto V., Giorgini F.A., De Santis G., D'Arpa S. A sequence of flaps and dissection exercises in the living model to improve the learning curve for perforator flap surgery. *Injury*. 2020 Dec;51 Suppl 4:S22-S30.

Поступила в редакцию 12.01.2021, утверждена к печати 18.02.2021
Received 12.01.2021, accepted for publication 18.02.2021

Corresponding author

Pierluigi Tos. E-mail: pierluigi.tos@asst-pini-cto.it

Автор, ответственный за переписку

Пьерлуиджи Тос. E-mail: pierluigi.tos@asst-pini-cto.it