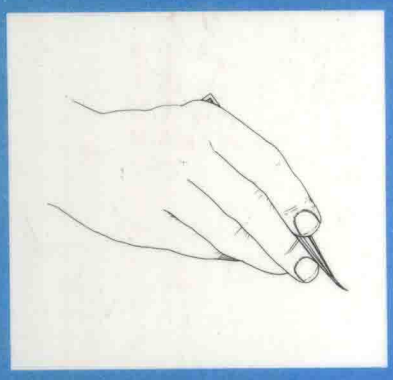
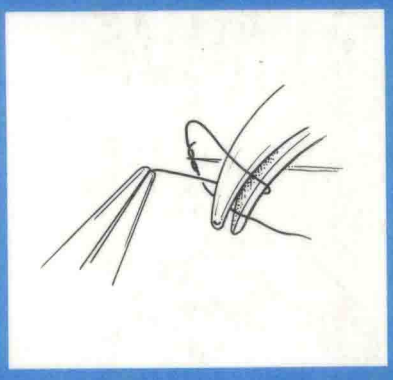
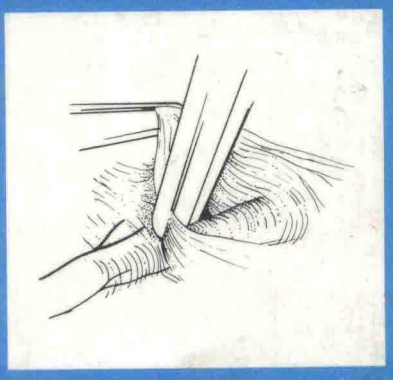
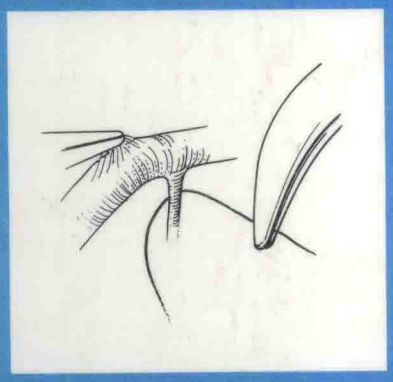
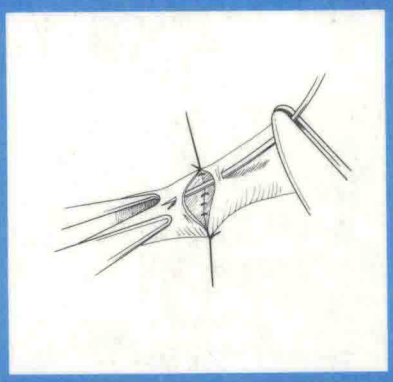
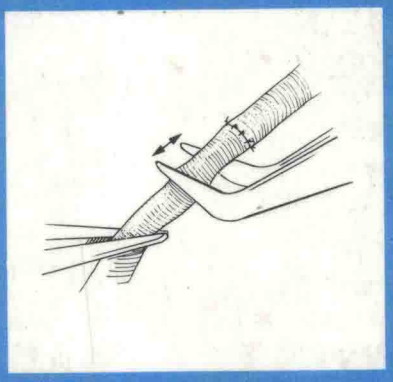
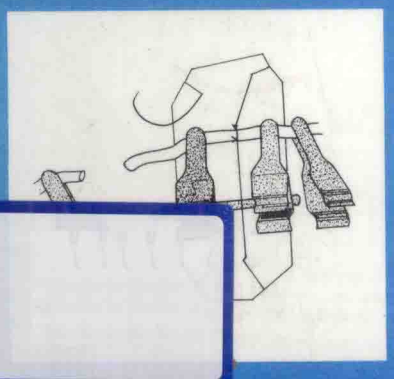
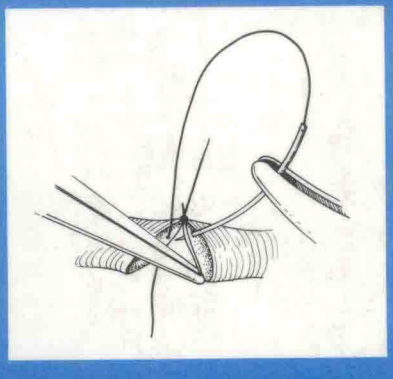
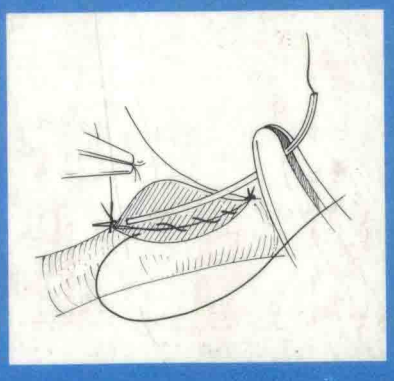
PRACTICE MANUAL FOR MICROVASCULAR SURGERY

Second Edition

Robert D. Acland

Practice Manual for Microvascular Surgery

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To my friend Frank Allen, a dedicated teacher of microsurgery

Preface

This manual is a practical step-by-step guide for the surgeon who intends to acquire a high level of basic skill in microvascular surgery by means of laboratory practice. Originally written for the use of trainees in the University of Louisville Microsurgery Laboratory, it has now been expanded and largely rewritten to meet a wider need. The second edition has been vigorously revised, with new illustrations throughout and new chapters on end-to-side continuous, and one-way-up anastomosis.

Many of the important principles and details of microsurgical technique described here are derived from the work and teachings of my fellow workers in the microsurgical field. In particular I wish to acknowledge my debts to Drs. Julius Jacobsen III, Harry J. Buncke, John R. Cobbett, Takao Harashina and Daniel Man.

I am also much indebted to the many trainees of the Center for Microsurgical Studies at the University of Louisville. Their successes and difficulties were the chief stimulus to the writing of this manual. Directly or indirectly they have provided many of the practical insights that are included here.

I have had the good fortune to be the Director of the Louisville Laboratory since its establishment in 1975. The Laboratory was set up as a center for microsurgical training and research with the professional and financial support of Drs. Harold E. Kleinert, Joseph E. Kutz, and Graham D. Lister, and with the advice and encouragement of Dr. Hiram C.

Polk, Jr., Chairman of the Department of Surgery at the University of Louisville. I am indebted to them all. I am most grateful to my secretary, Lynn Newton, for her work in the preparation of the manuscript.

Robert D. Acland

Contents

Introduction

The purpose of this manual is to help you learn the basic techniques of microvascular surgery. Even if you have already done a little of this work, I would respectfully suggest that you begin at the beginning. Many of the common sources of difficulty are covered in the early sections of the manual.

PRACTICE TIME

If you intend to learn as well and as rapidly as possible, do your utmost to set aside at least one uninterrupted week when you will have no commitments other than to be in the laboratory undisturbed. Learning microsurgery will initially make great demands on you. You should try to sleep well, be at peace with the world, and disengage yourself from the demands of the clock and the telephone. It is unrealistic to expect to learn well during hasty and sporadic sessions snatched out of a busy schedule when other responsibilities are clamoring for your attention.

At the onset, you may find it hard to believe that you will ever reach the stage where microvascular anastomosis becomes easy. When you do reach it, it will be because you have studied the apparent difficulties systematically and have learned to overcome them for yourself.

AVOIDING DESPERATION

There is no single stroke of magic in mastering microsurgical technique. Rather, the process involves learning to put together a large number of different points of detail, each one of which is simple and readily understood. Almost everyone finds that the first day or two are somewhat frustrating. Do not be

discouraged by this. Often it is when you seem to be progressing most slowly that you are in fact learning most. After one or two days you will reach a point where you suddenly seem to "get it all together" and the work will become a pleasure.

Remember that you are learning a technique in which the margin for error is measured in thousandths of an inch. Do not be alarmed by this. Accept it calmly, and it will help you to master each step thoroughly before progressing to the next. If you press on too fast, your learning will be incomplete. It is better to progress more slowly and to learn solidly.

DO NOT STRUGGLE WITH DIFFICULTIES—A FUNDAMENTAL RULE

If something is wrong, do not struggle on. If you do, one difficulty will lead to another, and dificulties lead to disaster. When a difficulty is perceived, *stop.* Whatever the difficulty—unwanted movement, an uncomfortable position, an eyepiece out of focus, a blood-stained field, a blunt needle, forceps that will not grip, untidy vessel ends, or a thread that you cannot pick up—do something about it before you go further. Either figure out what is wrong and put it right, or ask for advice.

SMOKING, COFFEE, AND OTHER BAD INFLUENCES

Smoking a cigarette will noticeably impair your concentration and performance for about 30 minutes. If you have to smoke at all, do it outside the laboratory. Stick to your normal coffee drinking habits. Admittedly coffee causes a slight tremor, but acute coffee withdrawal causes a worse one.

Two factors that give rise to more tremor than either coffee or smoking are irritation and strenuous manual exertion. Do your utmost to avoid having your practice time clouded by extraneous sources of irritation. In addition, do not allow yourself to become irritated at the difficulties that you face during practice sessions, but accept them as constructive experiences to be studied and overcome.

Strenuous manual exertion such as heavy lifting, playing tennis, or holding on to hip retractors will

make it very difficult for you to use your small muscles precisely. Such work leaves a residue of tremor for about 24 hours afterward and should therefore be avoided during the day preceding your start in the laboratory.

Lack of sleep will severely impair your learning performance. If you have been up all night, go and get some sleep.

DURATION OF PRACTICE SESSIONS

Avoid working for too long at a stretch. Your time in the laboratory is valuable and limited, but you will be using it uneconomically if you try to work right through the day without taking breaks. If you work in this way, you will suffer severe impairment of your judgment, your coordination, your ability to learn, and your ability to deal intelligently with difficulties. You should regularly take a break for ten minutes every hour. It is difficult to do this of your own volition, and frequently you will be advised by someone else that you should take a break. When this advice is given, do not resist it. The insistence on continuing when your performance has already fallen off is one of the first signs of impaired judgment. If someone advises you to take a break, take a break.

chapter 1 Equipment for microsurgical practice

This chapter describes all the equipment you need for the work described in this book. Addresses of supplying companies and catalog numbers of individual instruments can be found at the end of the book.

GET YOUR OWN INSTRUMENTS

The instruments needed for good microsurgical practice are few and simple, but they must be of excellent quality and they must be your own. If you do not yet have a set of good instruments, order them now and wait until they arrive before you start. Pay no attention to the widespread belief that any old, worn out, battered, or obsolete equipment is "good enough for the lab." It isn't.

The instruments described here are used in the Louisville Laboratory. They have been chosen for quality, inexpensiveness (where possible), and simplicity.

SPRING TENSION

Be sure that all the spring-handled instruments you choose have the right spring tension. If the tension is too weak, the tips will come all the way closed the moment you put enough pressure on the instrument to get it settled in your hand. If the tension is too firm, your thumb muscles will become painfully fatigued. To test the spring of an instrument for weakness, pick it up and hold it with just enough force that the tips are 1 to 2 mm apart. Then, maintaining just that force, pronate your forearm completely so that the instrument hangs upside

down. If it falls away from your hand, the spring is too weak. To test for excessive firmness, hold the instrument gently closed for 10 minutes. If you feel pain in your thenar muscles, the spring is too strong. Choose only instruments whose spring tension lies between these extremes.

JEWELER'S FORCEPS

Straight fine-pointed no. 3 jeweler's forceps (Fig. 1-1) are used almost continually in the non-dominant hand for tissue handling and suture tying. Their tips must be aligned with a precision of 1/1000 inch, since that is the diameter of 10/0 nylon. When closed with moderate pressure the jaws should meet not only at the tips but also evenly over a length of 3 mm so that thread can be picked up easily. The only jeweler's forceps good enough for microsurgery are those stamped with the trademark of Dumont. Dumont forceps from the recommended supplier are individually refinished under the microscope for microsurgical use.

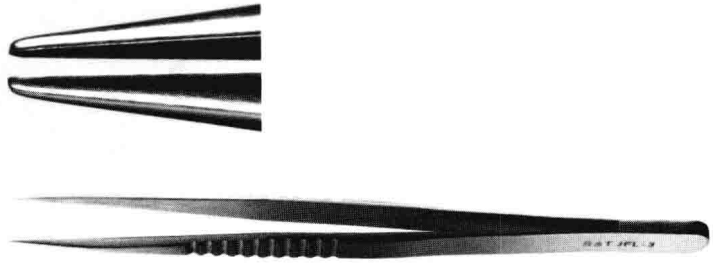

Fig. 1-1

ANGLED JEWELER'S FORCEPS

Angled jeweler's forceps (Fig. 1-2) have a number of special uses, including reaching under a vessel, tying

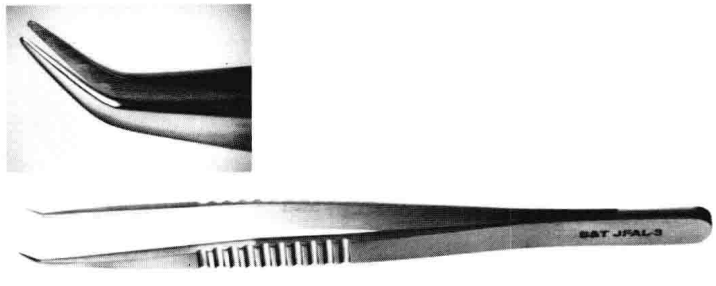

Fig. 1-2

knots, and doing patency tests. They should meet at the tips as exactly as the straight ones should do.

NEEDLEHOLDER

Pick a round-handled needle holder with fine, fully curved jaws and without a lock. Look for an open gap at the point shown by the arrow in Fig. 1-3. If that gap closes right up when the jaws close, your thread will often get trapped there.

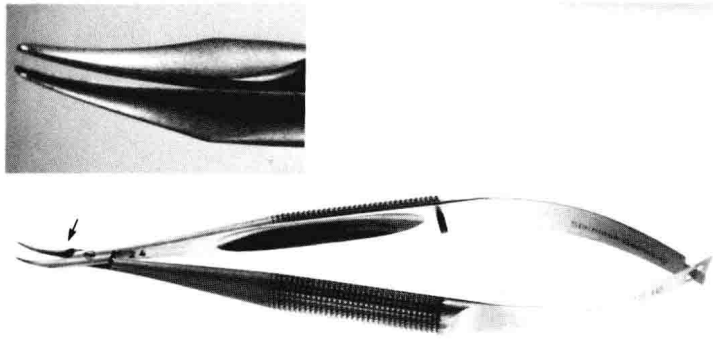

Fig. 1-3

VESSEL DILATOR

A vessel dilator is a modified jeweler's forceps with a slender, smoothly polished, nontapering tip (Fig. 1-4). It is put inside the vessel end and opened a little to produce gentle dilatation. It is also useful as a counterpressor for suturing in confined places.

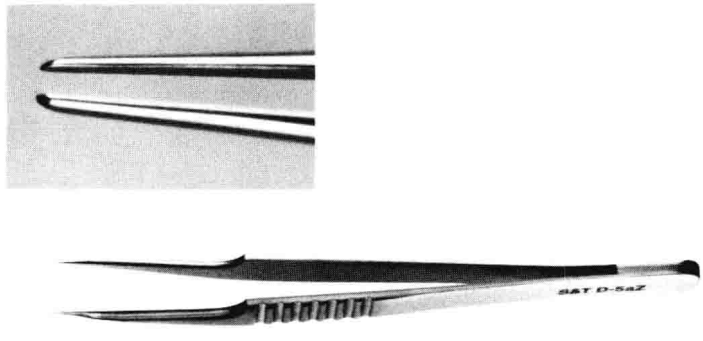

Fig. 1-4

DISSECTING SCISSORS

Dissecting scissors should be spring handled, should have gently curved blades, and should be lightly rounded at the tips (Fig. 1-5). The rounded tips are important. They enable you to dissect very closely

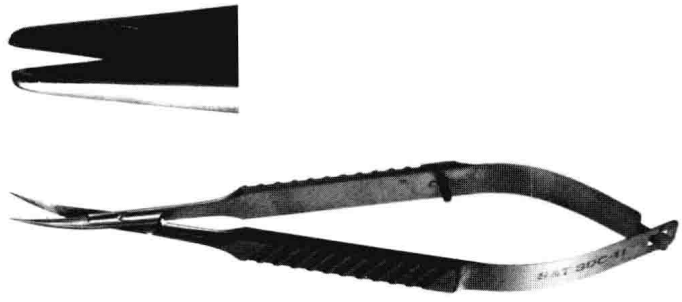

Fig. 1-5

along a vessel without the danger of making a hole in it.

ADVENTITIA SCISSORS

For the special task of trimming the adventitia off the vessel end, you need a pair of fine, straight microscissors with very sharp pointed tips (Fig. 1-6).

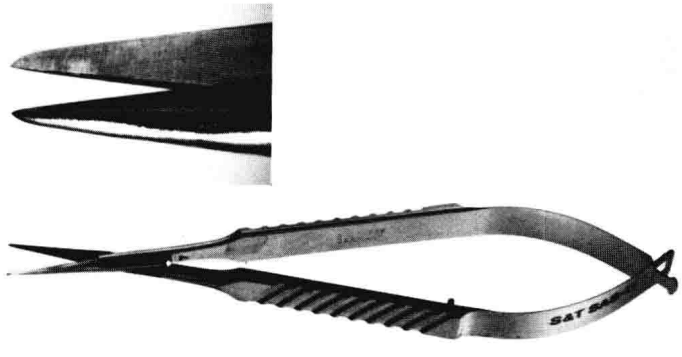

Fig. 1-6

The round-pointed dissecting scissors will not do this fine work properly. Their tips are too bulky for it. Adventitia scissors are also good for stitch-cutting: it does not damage them.

VESSEL CLAMPS

The full range of exercises described in this manual calls for the small collection of clamps shown below (Fig. 1-7, *A*). The set includes one comparatively large sliding approximator clamp with built-in suture-holding frame, for beginning anastomosis; a smaller plain approximator clamp for more

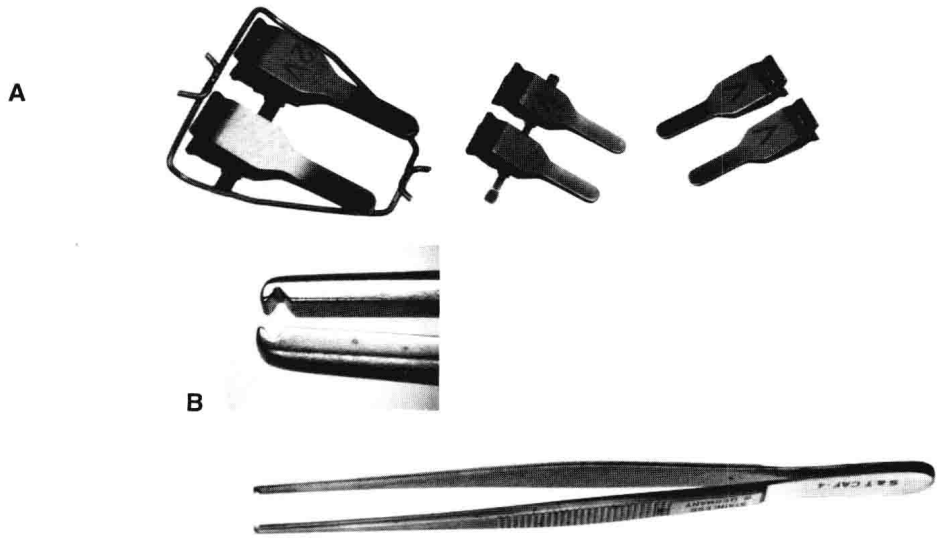

Fig. 1-7

advanced exercises; and two small single clamps. The clamps have flat gentle jaws. The larger ones, 11 mm in length, have a spring tension that is calibrated to make them almost harmless on vessels between 1.5 and 0.7 mm in diameter. The smaller 8 mm clampshave less closing force and are for vessels 1.0 to 0.4 mm in diameter.

Along with the clamps, you need a clamp-applying forceps Fig. 1-7, *B*—don't use any other instrument than this to apply clamps or take them off.

NONMICROSURGICAL INSTRUMENTS

For the macrosurgical tasks of incision and initial exposure you need a No. 15 scalpel, a pair of fine-toothed forceps, and a small pair of ring-handled scissors.

INSTRUMENT CASE

As soon as you get your instruments you must have a safe case to keep them in. If they are not kept in a good case, they will quickly be damaged. A proper instrument case is quite expensive. It is autoclavable and has a rack with a slot for each instrument. A

cigar box will do the job well enough at first. Fill it up with two layers of soft packing material, such as foam rubber, and keep the instruments sandwiched between the two layers so they cannot move around.

INSTRUMENT CARE

Take good care of your instruments and they will last a long time. Make it a rule that their tips will never touch another hard object. Keep them away from heavier instruments, do not pick them up more than one at a time, and avoid putting the tips down on the table. Do not lend them to anyone, ever.

The best way to clean microinstruments is to submerge them completely for 30 minutes in a hemolytic enzyme solution such as Hemosol. This dissolves even the hardest blood clot. Then rinse the instruments in water. Rinse the clamp hinges specially well with a brisk jet of water from a syringe. Then dry the instruments thoroughly before putting them away.

Minor repairs and readjustments can be made to the tips of jeweler's forceps with the aid of a fine pair of flat-jawed pliers, a small white Arkansas oilstone, and some 4/0 jeweler's emery paper. This work needs to be done under the microscope.

MAGNETIZATION

Occasionally instruments become magnetized from contact with a magnetized object, from contact with electrical equipment containing electromagnets, or from being reground. The only cure is an instrument demagnetizer, which is a simple, hollow, electric coil connected to the regular AC supply. Place the instrument inside the coil, switch on the current, slowly withdraw the instrument until it is 2 feet away, then switch off the current. A tape-deck demagnetizer will just suffice for treating instruments, but it is rather weak and must be used very slowly.

BIPOLAR COAGULATOR

The bipolar coagulator is indispensable for high-grade hemostasis. Using it effectively is one of

the basic skills you will be learning. A plain single-function bipolar unit is enough, together with a good pair of bipolar forceps. The best bipolar forceps are the inexpensive, semidisposable ones that come with a cord attached.

SUTURE

For suturing, use flat-bodied microvascular needles on 10/0 monofilament nylon. High-grade flat-bodied needles 100 and 75 microns in diameter are now readily available in unsterile "Lab Pack" packages. Use the 100-micron size for basic exercises, 75 micron for advanced exercises. Round-bodied needles, which are very hard to control, are happily almost a thing of the past.

MICROSCOPES

Do not get more microscope than you need. You can learn to do good work by yourself with a simple single-person microscope mounted on a bench stand. If you are setting up a laboratory where instruction will be given by an expert, you need a twin-head microscope; otherwise you don't. Foot-operated remote control for magnification and focusing is a great convenience, but is not truly a necessity. You can learn good technique on a hand-operated microscope.

The microscopes best suited for laboratory work are those made by Zeiss and by Wild. Microscopes of other makes tend to have imperfect optics, which sharply limit the precision of your work at high magnification. Zeiss and Wild optics are exactly comparable, despite what each manufacturer may claim. The illuminators of old Zeiss microscopes tend to be inadequate for work at high power; however, better illuminators can readily be retrofitted. The best focal length for the objective lens for general purposes is 200 mm provided you are of normal height. If you are exceptionally tall, a 300 mm objective will give you a better working position. The best eyepiece magnification is ×12.5. In a microscope having a magnification changer or zoom system of average range, the combination of ×12.5 eyepieces and 200 mm objec-