

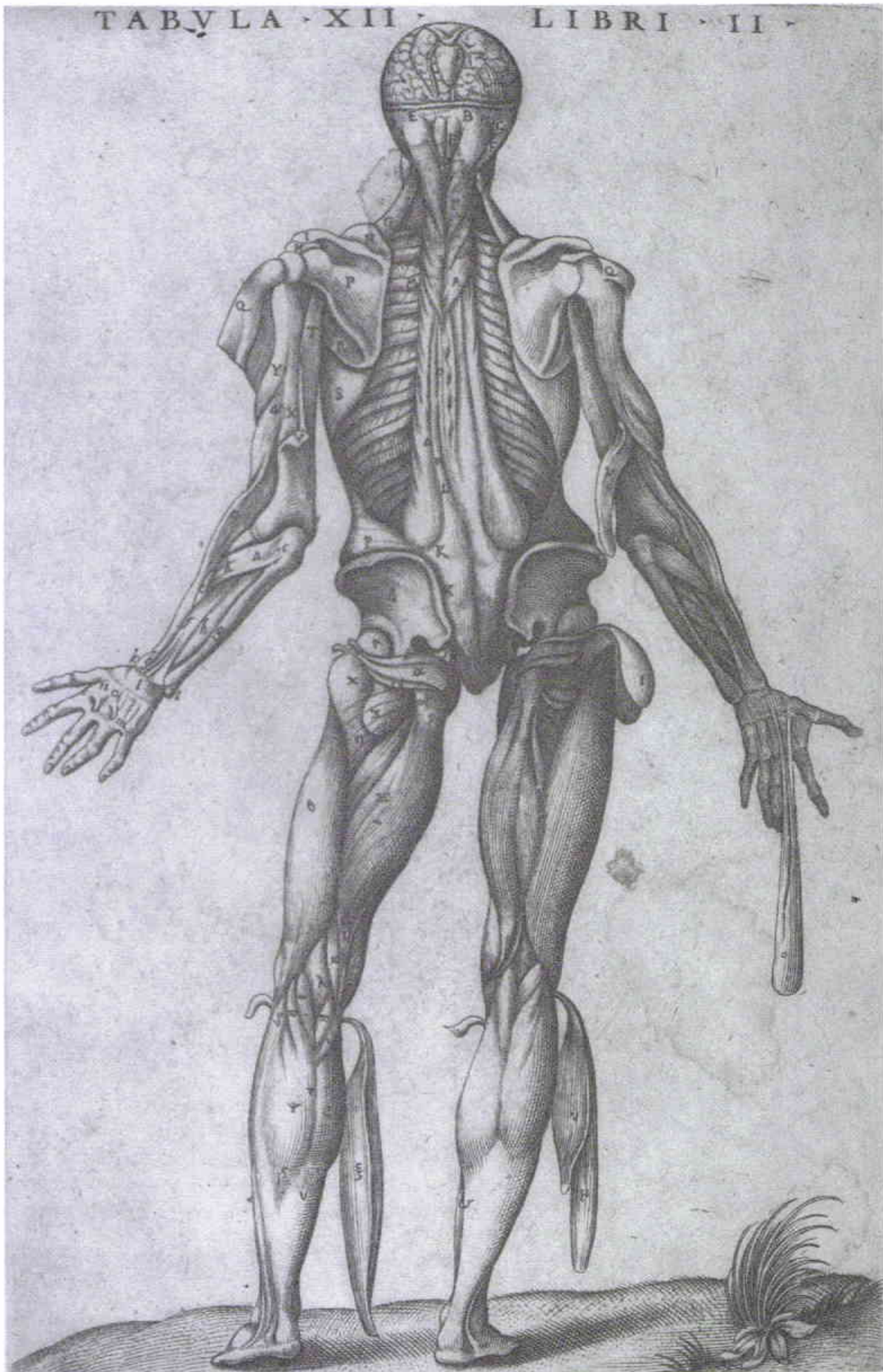
McCraw and Arnold's Atlas of Muscle and Musculocutaneous Flaps



John B. McCraw
Phillip G. Arnold



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**McCRAW and ARNOLD's ATLAS
of Muscle and Musculocutaneous Flaps**



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The reader should recognize that the procedures described in this Atlas may be fallible for reasons not described herein. This work represents the experience and the considered opinions of the authors.

The choice of an Atlas format and the chosen task of providing broad coverage of the many procedures necessitates an abbreviated textual content. The authors acknowledge the following limitations:

Based on cadaver dissections, appropriate descriptions were prepared for each procedure. These may not be completely correct anatomically, and are subject to reader interpretation.

The methods described have worked in the hands of the authors, but this may not be the experience of the reader.

No attempt has been made to list every possible source of technical error, risk, or complication.

The work is incomplete in regard to expected developments and risks, present and future.

The text is abbreviated and does not constitute a comprehensive course in these procedures. It may be advisable for the reader to undertake formal instruction in the technical aspects of these procedures prior to their application.

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To Paul W. Black, M.D. and Leonard T. Furlow, Jr., M.D.
Mentors, Colleagues, and Dear Friends

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FOREWORD

About two years ago, I asked John McCraw to mark out a few of his favorite musculocutaneous flaps on a cadaver for a book I was writing, to illustrate the importance of laboratory research in clinical surgery. Months, and then years went by, but nothing came from Norfolk. I have always been adequately intrigued by “Quick-Draw” McCraw to keep at least one eye on him and to suspect that during any long period of silence, he must be cooking something up. He was! In fact, he reversed my earlier request, with the same cavalier ease that he flips a cadaver flap, into a request for a Foreword to this book of flaps. As it turned out, McCraw, Arnold, Dibbell, and Murphy had already been five years into the making of this book, culling through well over 100,000 photographs, to obtain the final color pictures. Surprisingly, a less comprehensive version of this book was finished in 1980. Yet the authors postponed a possibly premature publication until a consensus opinion could be evolved in regard to the context of each flap, amongst the many choices of flaps available.

My immediate response to McCraw’s request (for a Foreword) was that I have always been wary of “cook-books,” not because they have no immediate value, which they often do, but because such books set up a routine and an inherent “gospel” which tends to promote mental stasis. After study of numerous completed chapters of this book, it became evident to me that the essence of this book is anatomy. And, as it takes hundreds of millions of years to alter anatomy, there seemed to be a good chance that the data presented here will serve as a guide of relatively permanent value.

The seed of this remarkable Atlas was sown when McCraw first studied intra-cellular calcium transfer in “island” rectus femoris muscle flaps in frogs in 1968. At the time, he was an Orthopaedic resident and an amateur physiology fellow at Duke. As a basic scientist, he was an admitted failure because the measured intra-cellular calcium transfer was no different between “island” muscle flaps and in-situ muscle flaps. He had wrongly anticipated a difference because of the expected ischemic differential between the two flap treatments. At least he became conversant with the concept of the “island” muscle flap, even if it was in the humble frog. Little did he know that he would face even greater failures (and successes) in humans in the years to come.

He then finished general surgery in Gainesville and graduated to a plastic surgery residency under Josh Jurkiewicz, who had already unleashed the creative genius of Luis Vasconez into the clinical applications of muscle flaps in the leg. Luis was impressed by the early work

of Ralph Ger, and Luis promptly involved McCraw because of his Orthopaedic background and interest in anatomy. Their comfort with muscle flaps led to the experimental study of musculocutaneous flaps in dogs, a study which could justifiably be transferred to human use. Residency came to an end, but the collaboration continued.

McCraw joined Dave Dibbell at the Wilford Hall USAF Hospital, and between 1973 and 1975 a dozen or more usable myocutaneous flaps were defined. This information was freely shared with a triangle of friends, which included the Atlanta group and P.G. Arnold at the Mayo Clinic, over the next several years. From there, each group went on to make independent and unique contributions. By 1978, McCraw and Dibbell offered their first experimental and clinical reports, which included a staggering 168 cases of myocutaneous flaps. Very soon, Arnold’s ingenious new developments and applications at the Mayo Clinic made these numbers pale by comparison.

These authors and their talented colleagues continued to work together in nine consecutive Norfolk Flap Workshops, and each year the teachers learned as much from the other teachers as the students learned from the teachers, at a time when the field was changing monthly. This book was finally composed in an attempt to solidify the material presented at these many workshops. At first, the questions were as naive as: “can you use this flap for cancer? can it be used for infections? and, can it be used just to fill a hole?” The obvious answers were: “Yes, yes, and yes.” Gradually, the questions became more and more sophisticated in regard to advantages, disadvantages, complications, and the rational choice of flaps, once the anatomy was known. Fortunately, the authors learned what the students wanted to know, in order to intelligently apply this new information — hence, this Atlas.

Now we are presented with a spectacular array of vivid fresh cadaveric dissections. The authors are to be commended for the uncommon feat of actually rendering cadavers colorful and exciting! The most commonly used muscle and musculocutaneous flaps are outlined, dissected in understandable stages, and transposed through their expected arcs of rotation. The clinical cases accurately portray the normal uses of these flaps, and the demonstrations of the inevitable complications are brutally honest. The text presents a concise account of pertinent anatomy, specific flap uses, regional flap comparisons, advantages, disadvantages, complications and pitfalls, as well as a short discussion about the donor

site. This presentation has been so expertly executed that it will make it relatively easy for other surgeons to use these most helpful flaps.

In our conversations, McCraw did state: "These cases cannot be presently duplicated by any other local method of reconstruction, and I doubt that they will be in the near future. Nevertheless, I do hope that they will be superseded, if ever, when I am in heaven so that someone else can write about it." It does seem likely that these authors will have exchanged their scalpels for harps before these flaps are surpassed, unless, that is, the cross-grafting barrier is broken. Then, these local

flaps will be discarded in favor of cadaveric microvascular "free" flaps to replace the exact missing unit at no physical expense to the patient. Even then, the anatomy depicted here will be pertinent.

This master guide book should be in the possession or within the reach of all reconstructive surgeons, both for their personal use and for the education of their patients, because it is the definitive work on the subject.

D. Ralph Millard, Jr.
Miami, Florida

PREFACE

What can we make of the current popularity of muscle and musculocutaneous flaps? Could this be just another passing fancy, or will this survive all of our surgical careers? We believe the latter, but seemingly fundamental advances can be ephemeral and can cloud our distant vision. This abbreviated presentation of our perceptions of the presently available muscle and skin-muscle flaps is offered, primarily, as an anatomical record which should not be outdated. Even if we develop totally reliable microvascular transfers which can be completed rapidly, these classic anatomical and rudimentary physiologic observations will still be pertinent.

We have tried to place each flap into the context of other similar flaps. In the process we may have discredited certain flaps and resurrected others, but we have tried to avoid any unwarranted flap "flattery." Ian McGregor explored this issue in his discussion of Ian Taylor's "extended deep inferior epigastric flap" article in the *Journal of Plastic and Reconstructive Surgery* (Dec. 1983):

One might be forgiven for believing that the recent flood of papers describing new myocutaneous flaps must surely be subsiding to a trickle. This paper by Taylor and co-workers, however, demonstrates that a persistent scrutiny of the vascular patterns of superficial muscles and the skin overlying them is still capable of revealing new potential flaps or extensions of existing flaps. The question, of course, might be asked whether more flaps are required, or whether a plethora does not exist already. To this the answer must be that when any flap is described, its ultimate value and its sphere of applicability cannot be gauged with any degree of accuracy. It is only with the passage of time and wide usage that possible value becomes actual and the method establishes its 'pecking order' in the flap hierarchy — in the front line or in the reserves. Clinical situations arise where, for one reason or another, a preferred technique cannot be used, and it is then that the availability of an armory of alternatives becomes more essential to provide a surgical 'defense in depth.'

This pre-eminent Professor of the British Commonwealth, and beyond, has offered this sage advice, which we have tried to follow. As Dr. Millard has mentioned in the Foreword, we have delayed publication of this Atlas for a period of years to validate Mr. McGregor's test of worth — the passage of time and wide usage.

P.G., Dave Dibbell, and I decided in 1979 to "do" this book. We chose to wait until our combined experience could allow us to offer good and lasting solutions

to some difficult reconstruction problems. Until recently the appropriate flap choices were quite debatable. Some problems still evade our best judgment and remain unsolved. However, on the issues which we have addressed, we feel comfortable with our comparisons of the available flaps and in our descriptions of their "personalities." New and better solutions will evolve, but this Atlas should be a good building block.

This book is called McCraw and Arnold's Atlas because only the two of us ended up writing the book. What was intended to be a simple recitation turned out to take seven years of nights and weekends. Yes, it was painful, but we both survived. Suffice it to say, our wives and families suffered more than we did. In the end P.G. wanted to call it McCraw and Arnold's Last Atlas so no publisher would ever ask us to produce another book.

Many people created the environment that allowed us to produce this book. The genesis of this book ultimately lies with our professors of surgery, Dr. Hugh Stephenson, Jr. and the late Dr. Nathan Womack, who initially encouraged us in the pursuit of surgery as a career and in basic research as a path to scientific expansion. We can never repay our debt to Dr. Leonard Furlow, Jr. and Dr. Paul W. Black for allowing us to emulate their surgical skills and personal caring. These two men not only conveyed concepts to us; they taught us how to think. Our surgical lives continue to be strongly influenced by them, but more importantly, our personal lives are brightened by their friendship — one of our special privileges. It was also our good fortune to be students of Dr. Maurice J. Jurkiewicz. Dr. "J" will undoubtedly be remembered in the surgical history of the Twentieth Century as a distinct pioneer in fostering surgical creativity in clinical experimentation which is balanced by human respect and compassion, in the context of the strictest ethical, moral, and scientific standards. The continuing financial support for many years of basic research was provided by the Taylor Foundation of Norfolk, Virginia, and by our friends Steve and Mary Lewis Campbell. The Campbells' encouragement and guidance ultimately facilitated the formation of the Hampton Press Publishing Co. and the completion of this Atlas. Our families, associates, and friends have seen us consumed by this project for many years. There is no way we can properly express our appreciation for the help and support they have given to us. Finally, our colleagues afforded us an unparalleled opportunity to pursue an earnest commitment to the new horizons of muscle flap surgery.

We are indebted to Dave Dibbell, Pat Maxwell, Brien Murphy, and Ann McMellin for the many hours

they devoted to dissecting and photographing the fresh cadavers. Two years were spent completing the flap dissections using a green background, but the artistic vision of Pat Maxwell interceded. This complete set of “green” photographs was discarded and replaced with a better “black velvet” set over the next five years. The scarcity of time and fresh cadavers prolonged the agony because it was necessary to photograph each flap dissection several times. Hence, each cadaver photograph used in the book represents several hundred photographs that were not used. The final photographs were completed in August 1986.

The contributions of Peter Pairolero, to the serratus and the intrathoracic chapters of this Atlas and to the development of these procedures, is significant and should be recognized. P.G. is grateful for his collaboration and for his friendship.

We would like to offer a special thanks to the plastic surgery residents and fellows at the Eastern Virginia Graduate School of Medicine over the past six years. Memory precludes a complete listing of all those who tirelessly helped with the cadaver dissections, but we must recognize Chris Papp, Hallene Marragh, Tom Arganese, Al Fleury, Bruce Freeman, Brien Murphy, Mike Norris, David Teasley, Mike Vincent, and Ivor Kaplan. The hours spent by John Grossman and Jeff Posnick in helping to compile the bibliography are also appreciated. Above all else, this time in the laboratory was fun and has left us with fond memories of the camaraderie with our friends.

This Atlas would certainly never exist without the endless ebullience and creativity of Ann McMellin. She deserves our sincerest thanks for overseeing every aspect of the production, printing, and publication from start to finish. Germaine Clair, who designed the Atlas with

consideration of the practical needs of the reader and while maintaining our commitment to artistry and excellence, has contributed to many aspects of this project. For the actual production of the Atlas, our thanks to Greg Jordan and the numerous people at Teagle and Little printers who adeptly implemented our vision, and especially to Elawna Sisley, who, somehow, knew where everything was during the entire project. Several secretaries gave special attention to compiling the text. They include Vicky Martin, Laurie Blaine, Judith Tessmer, Billi Jo Hardesty and many Kelly Girls. Their contributions were essential to the success of the project.

This *Atlas* should not be considered as the ultimate answer, nor even complete. It is a guide to work from and it should be supplemented by personal dissections, formal training and individual experience. Still, there may never be a “final answer.” Flap surgery is a little like playing a chess game designed by a sardonic Nature, who does not reveal all the rules of the game. What is flap *delay*? What is vascular *spasm*? Why should *cold* be harmful, when it is helpful in so many other conditions? What can we do to remedy a *dying flap*? How can we ever see “inside” the *physiology of the micro-circulation*? At the present time, we are only moving through the early stages of anatomical description. We still have just a rudimentary knowledge of the physiologic reasons for our successes or failures. Maybe in the future this same sardonic Nature will reveal the rules of this “chess game.” Then, we will have an opportunity to understand both the physiology and anatomy of muscle flaps. We envy the surgeons who will be afforded this view.

John B. McCraw
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