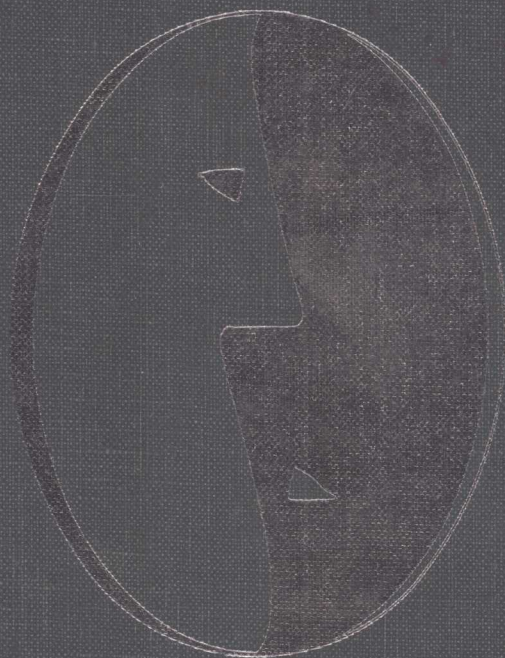

LEONARD R. RUBIN

THE
PARALYZED
FACE

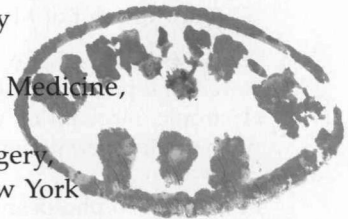


1/R716

THE PARALYZED FACE

Leonard R. Rubin, M.D., F.A.C.S.

Diplomate, American Board of Plastic Surgery
Clinical Professor of Plastic Surgery,
State University of New York at Stony Brook School of Medicine,
Stony Brook, New York
Attending Surgeon, Plastic and Maxillofacial Surgery,
Nassau County Medical Center, East Meadow, New York
Director, The Center for Facial Paralysis,
Garden City, New York



with 312 illustrations

NOT FOR RESALE



**M Mosby
Year Book**

St. Louis Baltimore Boston Chicago London Philadelphia Sydney Toronto

Editor: *Anne S. Patterson*
Assistant Editor: *Maura K. Leib*
Project Manager: *Mark Spann*
Production Editor: *Daniel J. Johnson*
Designer: *Liz Fett*

Copyright © 1991 by Mosby-Year Book, Inc.
A Mosby imprint of Mosby-Year Book, Inc.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher.

Permission to photocopy or reproduce solely for internal or personal use is permitted for libraries or other users registered with the Copyright Clearance Center, provided that the base fee of \$4.00 per chapter plus \$.10 per page is paid directly to the Copyright Clearance Center, 27 Congress Street, Salem, MA 01970. This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotional purposes, for creating new collected works, or for resale.

Library of Congress Cataloging-in-Publication Data

The Paralyzed face / [edited by] Leonard R. Rubin.

p. cm.

Includes bibliographical references and index.

ISBN 0-8016-4570-0

1. Facial paralysis—Surgery. 2. Facial paralysis—Pathogenesis.

I. Rubin, Leonard R., 1912-

[DNLM: 1. Facial Paralysis. 2. Facial Paralysis—surgery.

3. Surgery, Plastic—methods. WL 330 P222]

RD523.P33 1991

617.5'2—dc20

DNLM/DLC

for Library of Congress

91-14165
CIP

Printed in the United States of America

Mosby-Year Book, Inc.
11830 Westline Industrial Drive, St. Louis, Missouri 63146

GW/MY/MV 9 8 7 6 5 4 3 2 1

Contributors

Howard Barrow, M.D.

Resident, Department of Otolaryngology
Manhattan Eye, Ear, and Throat Hospital
New York, New York

Joseph Brudny, M.D.

Clinical Associate Professor, Department of Rehabilitation Medicine
New York University Medical Center
New York, New York

Bruce M. Carlson, M.D., Ph.D.

Professor and Chairman, Department of Anatomy and Cell Biology
University of Michigan
Ann Arbor, Michigan

Jeffrey Cole, M.D., D.P.M.R., F.A.A.P.M.R.

Chief, Neuromuscular Electrodiagnostic Services
Department of Rehabilitation Medicine
St. Luke's/Roosevelt Hospital Center
New York, New York
Assistant Professor of Clinical Rehabilitation Medicine
Columbia Presbyterian, New York, New York

Roger L. Crumley, M.D.

Professor and Chief, Department of Otolaryngology—Head and Neck Surgery
University of California Irvine Medical Center
Orange, California

John A. Faulkner, Ph.D.

Professor, Department of Physiology
University of Michigan
Ann Arbor, Michigan

Vivian Frisch, R.N., Bs.N.

Staff Nurse, Operating Room Holding Area
Winthrop University Hospital
Mineola, New York

Sidney Gerson, P.T.

Registered Physical Therapist, Clinical Instructor
LaGuardia Community College
Long Island City, New York

Lars Hakelius, M.D.

Professor of Plastic Surgery, Department of Plastic and Hand Surgery
University Hospital
Uppsala, Sweden

Kiyonori Harii, M.D.

Professor and Chairman, Department of Plastic Surgery
Faculty of Medicine
The University of Tokyo
Tokyo, Japan

George T. Hashisaki, M.D.

Assistant Clinical Professor, Department of Surgery
Division of Otolaryngology—Head and Neck Surgery
University of California Irvine Medical Center
Orange, California

P.A. Vinod Kumar, M.B.B.S., M.S., M.Ch., M.N.A.M.S

Microsurgery Research Fellow and Clinical Assistant
Plastic and Reconstructive Surgery Unit and Microsurgery Research Centre
St. Vincent's Hospital
Melbourne, Australia

Sydney Louis, M.D.

Professor and Associate Chairman, Program in
Neurology
Department of Neurosciences
Rhode Island Hospital
Brown University
Providence, Rhode Island

Mark May, M.D., F.A.C.S.

Clinical Professor, Department of Otolaryngology—
Head and Neck Surgery
University of Pittsburgh
Pittsburgh, Pennsylvania
Director, Facial Paralysis Center
Shadyside Hospital
Pittsburgh, Pennsylvania

Leonard I. Malis, M.D.

Professor and Chairman, Department of Neuro-
surgery
Mount Sinai School of Medicine
New York, New York

Pamela McKnight, M.D.

Assistant Clinical Instructor of Neurosciences,
Department of Neurology
Rhode Island Hospital
Brown University
Providence, Rhode Island

Hanno Millesi, M.D.

Professor of Plastic Surgery
Head, Department of Plastic and Reconstructive
surgery, 1st Surgical Clinic, University of Vienna
Medical School
Director Ludwig-Boltzmann Institute for Experi-
mental Plastic Surgery
Vienna, Austria

**Bernard McC. O'Brien, C.M.G., B.Sc., M.D.,
M.S., F.R.C.S., F.R.A.C.S., F.A.C.S.,
F.R.C.S.Ed. (Hon.), F.A.C.S. (Hon.)**

Director, Microsurgery Research Centre
St. Vincent's Hospital
Melbourne, Australia

Simon C. Parisier, M.D.

Chairman, Department of Otolaryngology
Manhattan Eye, Ear, and Throat Hospital
New York, New York

Calvin L. Rasweiler, M.D., F.A.C.S

Associate Professor of Clinical Surgery
State University of New York at Stony Brook
School of Medicine, Stony Brook, New York
Chief of Head and Neck Surgery and Attending
Surgeon
Winthrop University Hospital and Mercy Hospital
New York, New York

J. Peter Rubin, B.A.

Medical Student, Tufts University School of
Medicine
Boston, Massachusetts

Leonard R. Rubin, M.D., F.A.C.S.

Diplomate, American Board of Plastic Surgery
Clinical Professor of Plastic Surgery
State University of New York at Stony Brook School
of Medicine
Stony Brook, New York
Attending Surgeon, Plastic and Maxillofacial
Surgery
Nassau County Medical Center
East Meadow, New York
Director, The Center for Facial Paralysis
Garden City, New York

Judith A. Sawchak, M.D.

Assistant Professor, Department of Neurology
State University of New York Health Science Center
at Brooklyn
Brooklyn, New York

Joanna Hollenberg Sher, M.D.

Distinguished Service Professor, Department of
Pathology
State University of New York Health Science Center
at Brooklyn
Brooklyn, New York

Roger L. Simpson, M.D.

Director, Plastic and Reconstructive Surgery
Nassau County Medical Center
East Meadow, New York
Assistant Clinical Professor of Surgery
State University of New York at Stony Brook

Stephen M. Sobol, M.D.

Otolaryngology—Head and Neck Surgery
Decatur Memorial Hospital
Decatur, Illinois
Facial Paralysis Center
Shadyside Hospital
Pittsburgh, Pennsylvania

Robert C. Wang, M.D.

Resident Coordinator, Department of Otolaryngology
Manhattan Eye, Ear, and Throat Hospital
New York, New York

Michael H. Weiss, M.D.

Attending Physician, Manhattan Eye, Ear, and Throat Hospital
New York, New York
Memorial-Sloan Kettering Cancer Center
New York, New York
Clinical Assistant Professor of Otorhinolaryngology
Cornell University Medical College

Stephen I. Zimmerman, Ph.D., P.T.

Registered Physical Therapist, Clinical Instructor
LaGuardia Community College
Long Island City, New York

This book is dedicated to the countless thousands who have been afflicted with the horror of facial paralysis. May the information found in this book guide those of us who have accepted the task of returning these people to the mainstream of society.

Preface

No animal in the evolutionary tree has attained the range of facial expression displayed by humans. The human face is a mirror of the inner emotions, conveying love, hate, and a myriad of subtle, fleeting gradations from joy to deep despair. The expressions tied in with the muscle movements about the eyes and mouth translate these emotions to others. All of this is lost when the face is paralyzed.

The past three decades have seen a dramatic attempt to restore animation to the paralyzed face. No longer content to hold passively the sagging face with static facia, surgeons have transposed contiguous facia and muscles to give dynamic movement to the affected side. Research into the histopathology of nerve and muscle has helped overcome previous failures of free striated muscle grafting after free nerve conduits were created. The microscope in the surgical procedure has enabled the use of the finest of sutures to minimize nerve scar formation.

Research has focused on finding a motor nerve stimulant, enzyme, endocrine, or chemical. A motor nerve stimulant would entice the nerve cell body to quickly form new axons that could bridge the site of

nerve interruption before scar tissue created a permanent impassable barrier. As of now, there are hints of possible success.

In the past decade many articles and books have been written on the facial nerve. Some have been scientific, some hold wishful thinking, several have been pedantic, and a few pragmatic. This new volume is designed to present realistically how we reanimate the paralyzed face with tested techniques immediately after paralysis or at a later period. Detailed description of techniques will be aided by photographs and sketches.

As of now, we cannot obtain complete restoration of function for the paralyzed face. However, as the years pass and research in nerve and muscle physiology unravel the mysteries, the goal comes closer. Special chapters have been devoted to partial facial paralysis, eyelid closure, the hemiparalytic tongue, and biofeedback techniques. This edition has been enhanced by a distinguished international group of surgeons who discuss their expertise in final reanimations.

Leonard R. Rubin

The Physician and Facial Paralysis Patients

The male gynecologist knows he is not a candidate for uterine cancer, and the female proctologist knows she is exempt from cancer of the prostate. Immunity from the illnesses they treat gives them an objectivity that precludes the empathy that only those who are susceptible to the disease can feel. The majority of physicians treating facial paralysis exhibit the same attitude as the female proctologist and the male gynecologist: "It can't happen to me."

Facial paralysis victims seek the surgeon's skill to restore the aesthetic appearance and facial function that will enable them to regain a pre-paralysis lifestyle. By the time the patients see the doctor, they may have experienced red and swollen eyes that are constantly open to infection, lips that cannot pucker, and a mouth that cannot smile. Mastication results in saliva trickling out of the corners of the mouth, and the patient struggles incessantly to keep this fluid, awash with food particles, from flooding the chin and streaming down the neck. Speech is always affected. The damaged muscles form a marked facial asymmetry that causes a grossly abnormal image, an inability to show facial expression, and even the strongest self-esteem to wither.

In a social setting, the face looks alien. Difficulties with articulation and hearing further accentuate the effect. People interact fearing that the condition is contagious; the simple amenities of handshaking and cheek kissing become embarrassing as individuals who are traditionally demonstrative shy away from touching. The patients shun reflective surfaces, dining in public, and conversing with strangers. They are sensitive to the stares of people with their silent questions and are devastated by the curious remarks of children. Family and friends want to be supportive; in their concern and confusion they fluctuate between excesses of solicitude and retreat. These individuals may also suffer economically because the job market

may view them as handicapped. Employers and co-workers are uncomfortable with their frozen faces, and they are anxious about their mental capabilities. They associate facial function with intelligence, wrongfully assuming that one is contingent upon the other. In contrast, the insurance companies know that most facial paralysis patients are intellectually functional, and that their paralysis is not transmittable. But good health disqualifies them from disability compensation unless their face is their "fortune." No consideration is made from the workplace's discrimination against facial paralysis, which in effect makes these patients disabled workers. It is a most frustrating position to be in!

How do the patients cope emotionally with the social and economic complications of facial paralysis? Much of the resolution will be determined by the program the physician structures for the repair of the face and the renewal of the spirit.

The surgeon's first procedure on this agenda is to communicate to his patients that he fully understands how facial paralysis has changed every aspect of their lives for the worse. Once he has established that he is aware of their pain and anguish, he may continue on to the fact of their having correctable deformities that are not life-threatening. The facial paralysis patients' reactions to the surgery are unduly tethered to their response to the surgeon as a person who "feels" for them. In essence, the postoperative mirror is the achievement of seeing the physician as a surgeon and a humanist.

The patient-physician relationship is identified by one of two broad patient categories: the initially dependent patient (IDP) and the secondary skeptical patient (SSP).

The IDP seeks miracles and looks upon the doctor as a savior. This patient should be educated about the limitations of the restorative process. If the patient

cannot be educated at the outset and persists in naive and unrealistic expectations, the surgeon must acknowledge that any treatment undertaken will dissatisfy the patient because it can never equal the patient's original face and function. A patient who cannot be pleased pressures the doctor into a subliminal posture of defensive medicine. Consequently, the doctor must choose either to treat the patient conservatively, hoping a little will go a long way in bringing the patient closer to reality, or to send the IDP "elsewhere."

The SSP has received negative results elsewhere (not as an IDP) and no longer trusts the physician to repair, reanimate, or reconstruct any part of the facial paralysis. The patient is consulting the physician only under protest. The patient's hopelessness and disbelief present the surgeon with the ultimate surgical and psychological challenge and inadvertently make the surgeon an apologist for the specialty. Time and pa-

tience are needed to explain to the patient why the previous result is as it is, without putting "elsewhere" in litigious jeopardy, and still motivate the SSP for what must be done. As progress is made, the SSP becomes cautiously optimistic and very appreciative. This recognition of the surgeon's proficiency is hard won and is not only praise for the surgeon but a vindication for the specialty. It also stimulates the surgeon's academic and artistic creativity. The SSP is the recipient of the innovations.

Facial paralysis patients and the plastic surgeon are united in mutual goals. Patients want perfect healing, and the surgeon heals within the ever-expanding bounds of reconstructive perfection. The constant perfection that exists for both comes from the surgeon's compassion for his patients as he realizes his own vulnerability, that "this can happen to me."

Annette R. Rubin

**THE
PARALYZED
FACE**

Contents

PART I Facial Muscles and Nerves, 1

- 1 The Anatomy of the Facial and Contiguous Facial Muscles, 3
LEONARD R. RUBIN
Functions of the muscles of the face, 3
The muscles of the forehead and eyelids, 3
The ancillary facial muscles, 9
- 2 Expressions of Emotions: The Role of the Nasolabial Fold and the Anatomy of the Smile, 11
LEONARD R. RUBIN
The nasolabial fold, 11
The anatomy of the smile, 12
Effects on expression, 14
Summary, 15
- 3 Anatomy of the Facial Nerve, 16
ROGER L. SIMPSON
Intratemporal, 16
Extratemporal, 17
Summary, 18
- 4 Pathophysiology of Denervation in Facial Neuromuscular Motor Unit, 19
JUDITH A. SAWCHAK
JOANNA HOLLENBERG SHER
Normal skeletal muscle structure and function, 19
Postdenervation changes in the muscle fiber and motor end plate, 23
Conclusions, 27
- 5 Facial Muscle Electrodiagnostics and Electrophysiological Assessment of Functional Strength After Injury, 30
JEFFREY L. COLE
Electrodiagnostic studies, 31
Residual muscle function analysis, 35
Analysis of data, 37
- 6 Free Muscle Grafts—Laboratory Studies, 40
BRUCE M. CARLSON
JOHN A. FAULKNER
Types of muscle grafts in the face, 40
Reinnervation of grafted muscle, 41
Adaptation to the face, 42
Unanswered problems in muscle transplantation, 42
- 7 Reinnervation and Regeneration of Striated Muscle, 44
JUDITH A. SAWCHAK
JOANNA HOLLENBERG SHER
Reinnervation and nerve implantation, 44
Regeneration of striated muscle, 49
Conclusions, 52
- 8 Nerve Grafting, 55
HANNO MILLESI
General remarks, 55
Special problems related to the facial nerve, 56
Indications, 59
- 9 Nerve Growth Factors, 65
J. PETER RUBIN
Nerve growth factor, 65
Role of nerve growth factor in the nervous system, 67
Basement membrane glycoproteins, 69
Muscle derived growth factors, 70
Peripheral nerve regeneration, 71
- 10 Diagnosing the Site of the Facial Nerve Lesion by Anatomical Location, 77
ROGER L. SIMPSON
Anatomy of the facial nerve, 77
Clinical evaluation, 78
Summary, 79

- 11 Congenital Facial Paralysis, Including Möbius' Syndrome, 80**
 LEONARD R. RUBIN
 Background, 80
 Clinical characteristics, 80
 Mental factors, 80
 Etiological factors, 82
 Summary, 85
- 12 Medical Causes of Facial Paralysis, Including Bell's Palsy, 87**
 SIDNEY M. LOUIS
 PAMELA McKNIGHT
 Categories of unilateral facial palsy, 87
 Lower motor neuron palsies, 87
 Other lower motor neuron palsies, 88
- 13 Diagnosis of Disorders Within the Temporal Bone Causing Facial Paralysis, 91**
 ROBERT C. WANG
 HOWARD BARROW
 MICHAEL H. WEISS
 SIMON C. PARISIER
 Anatomy, 91
 History—symptoms and signs, 93
 Classifications of facial palsy, 94
 Site-of-lesion and electrical testing, 94
 Bell's palsy, 95
 Intratemporal causes of facial paralysis, 95
 Primary temporal bone neoplasms, 97
- 14 Surgical Causes of Facial Paresis, 101**
 CALVIN L. RASWEILER
 Facial nerve—parotid gland relationship, 101
 Nonsurgical causes of nerve disruption, 101
 Surgical causes of nerve disruption, 101
 Surgical approaches, 101
 Summary, 102
- PART II Reanimation Techniques for the Paralyzed Face, 105**
- 15 Nonsurgical Neuromuscular Rehabilitation of Facial Muscle Paresis, 107**
 JEFFREY L. COLE
 STEPHEN I. ZIMMERMAN
 SIDNEY GERSON
 Treatment approaches and therapeutic considerations, 107
 Additional postsurgical rehabilitation considerations, 111
- 16 Medical Treatment for Bell's Palsy, 113**
 SYDNEY M. LOUIS
 PAMELA McKNIGHT
 Prognosis, 113
 General therapy, 113
 Specific therapy, 114
- 17 Early Surgical Treatment for Bell's Palsy and Ramsay-Hunt Syndrome, 116**
 ROGER L. CRUMLEY
 GEORGE T. HASHISAKI
 Bell's palsy, 116
 Ramsay-Hunt syndrome, 117
 Prognostic testing in facial paralysis, 117
 Surgical approaches to the facial nerve, 118
 Conclusions, 120
- 18 The Facial Nerve in Tumors of the Cerebellopontine Angle, 122**
 LEONARD I. MALIS
 General surgical approach, 122
 Acoustic neuromas, 123
 Other tumors of the angle, 124
 Outcome of surgical treatment, 124
 Preservation of facial function and hearing, 124
 Opportunities for improvement, 125
- 19 Surgical Treatment of Lesions Within the Temporal Bone, 127**
 MICHAEL H. WEISS
 SIMON C. PARISIER
 ROBERT C. WANG
 Surgical approaches to the facial nerve, 128
 Infections, 132
 Trauma, 133
 Neoplasms, 134
- 20 Hypoglossal-Facial Anastomosis: Its Role in Contemporary Facial Reanimation, 137**
 STEVEN M. SOBOL
 MARK MAY
 History, 137
 General concepts, 137
 Indications, timing, and considerations, 138
 Anatomical and physiological aspects, 139
 Expectations and results of hypoglossal-facial anastomosis, 139
 Disturbance of tongue function, 141
 Operative technique, 141
 Combining reanimation techniques, 141

- 21 The Treatment of Permanent Facial Palsy with Free Muscle Transplants Without Vascular Anastomoses, 144**
LARS HAKELIUS
Principles of free muscle transplantation, 144
Indications, 144
Operative technique, 145
Paralysis of the orbicularis oculi, 145
Paralysis of the orbicularis oris, 149
Partial paralysis of the elevators of the angle of the mouth, 152
Results, 152
- 22 Reanimation of Total Unilateral Facial Paralysis by the Contiguous Facial Muscle Technique, 156**
LEONARD R. RUBIN
Review of the anatomy of the temporalis, masseter, and frontalis muscles, 156
Prerequisites for the use of the contiguous facial muscles, 157
Postoperative course, 168
- 23 Microneurovascular Free Muscle Transplantation, 178**
KIYONORI HARI
Purpose of the operation, 178
Concept of the operation, 178
Operative procedure (Method 3), 182
Postoperative care and course, 186
Results, 186
Discussion, 187
- 24 Cross-Face Nerve Grafting with Free Vascularized Muscle Grafts, 201**
BERNARD MAC. O'BRIEN
P. A. VINOD KUMAR
Indications of free muscle transfer, 201
Operative technique, 201
Results, 206
Conclusion, 212
- 25 Reanimation of Congenital Facial Paralysis, Including Möbius' Syndrome, 213**
LEONARD R. RUBIN
Surgical technique, 213
Postoperative course, 213
Summary, 213
- 26 Reanimation of the Partially Paralyzed Face, 220**
LEONARD R. RUBIN
Presurgical evaluation, 220
When to correct a partial facial paralysis, 220
Reanimation techniques for partial facial paralysis, 221
Postoperative considerations, 227
Summary, 227
- 27 Reanimation of the Hemiparetic Tongue, 228**
LEONARD R. RUBIN
Tongue anatomy, 229
Surgical technique, 230
Discussion, 233
Conclusions, 233
Summary, 233
- 28 Reanimation of the Paralyzed Eyelid, 234**
LEONARD R. RUBIN
Reanimation procedures, 234
Summary, 242
- 29 Exercises Following Surgery for Facial Reanimation, 243**
VIVIAN FRISCH
The program, 243
- 30 Biofeedback in Facial Paralysis: Electromyographic Rehabilitation, 247**
JOSEPH BRUDNY
Biofeedback, 247
Electromyographic rehabilitation (EMGR), 247
Facial paralysis study, 251
Results, 258
Discussion, 261
Summary, 263

PART I

Facial Muscles and Nerves

The 14 chapters of Part I are concerned with fundamental studies of the facial muscles and nerves. When paralysis occurs, reanimation procedures require exact knowledge of the normal anatomy as well as the mechanisms of degeneration whenever nerve impulses are interrupted.

Chapter 2 on the anatomy of the smile and the role played by the nasolabial fold in developing the smile serves as the norm for comparison with a paralyzed side, whatever the etiology. By understanding the normal mechanisms, reconstruction techniques can proceed to create mirror-image reanimation, bringing the impaired side into balance with the normal side of the face.

The studies of the pathophysiology of neuromuscular degeneration presented by Drs. Judith Sawchak and Joanna Hollenberg Sher (Chapter 4) and the fate of free striated muscle grafts discussed by Dr. Bruce Carlson (Chapter 6) tell us what happens when facial paralysis occurs and what substitutes are needed to provide replacement nerve and muscle activity. Nerve growth factors, the key to nerve regeneration, are thoroughly discussed in Chapter 9 by J. Peter Rubin. Rounding out the fundamental studies are the electronic studies of nerve site disruption presented in Chapter 5 by Dr. Jeffrey Cole and Dr. Roger Simpson's (Chapter 10) description of the technique for pinpointing the site of pathologic process on an anatomical basis.

The etiologies of facial paralysis are numerous. The most common cause is a viral attack on the facial nerve within the facial canal, typically caused by the herpes simplex virus, which results in a temporary paralysis known as Bell's palsy. A far more lasting paralysis is caused by the herpes zoster virus. These and other infectious causes of facial paresis are discussed by Dr. Sydney Louis. The mystery of congenital facial paralysis has not yet been solved. Microanatomic studies of Möbius (the name used to describe a syndrome of bilateral facial paralysis with associated cranial nerve disease and limb deformities) specimens by numerous investigators have shown that there is a dysplasia of nerve and muscle with intact elements of each present. The syndrome, which has been expanded to include individuals with unilateral facial paralysis, is discussed in detail in Chapter 11 by Dr. Leonard Rubin. The roles of tumors and trauma in causing facial paralysis are reviewed by leaders in their specialties, including Drs. Leonard Malis (Chapter 18), Simon Parisier (Chapter 13), and Calvin Rasweiler (Chapter 14).

CHAPTER ONE

The Anatomy of the Facial and Contiguous Facial Muscles

LEONARD R. RUBIN

FUNCTIONS OF THE MUSCLES OF THE FACE

The muscles of the face serve a dual purpose: (1) to act as a cover for the mouth cavity and to provide protection for the eyeballs and (2) to open and close the oral cavity and the eyelids. The contractions and relaxations of these muscles throw the overlying skin into many folds, supplying a bonus of facial expressions that can mirror the inner emotions. The patterns created make the variations in smiles. The subtle portrayal of emotions by delicate gradations of muscle contractures is made possible by the intimate relationship of the superficial fascia with the muscles and the overlying skin.

The deep fascia⁴ coming up from the neck splits into deep and superficial layers as it encounters the mandible. The superficial layer invests the platysma and then advances to the cheeks where the superficial facial muscles are enveloped. In the cheeks, the fascia, which adheres to the muscles, sends fibrous septa to the overlying dermis, thereby making the latter responsive to the slightest muscle contracture. Deep to this layer, pockets of fat make up the space between the buccinator and the rest of the facial muscles.

The foundation for the facial muscles is found in three facial sphincters: the covers for the two eyeballs and the cover of the lips. The orbicularis oculi receive the forehead muscle insertions, whereas the cheek muscles terminate into the orbicularis oris of the lips.

The importance of the superficial fascia² cannot be overemphasized. It acts as a distributor of the facial muscle movements to the skin. Because different muscles contract with varying strength, the number of facial movements becomes infinite and the extent is wide ranging, especially because the transmissions

of these forces are blended by the network of overlying facial skin attachments. This allows for a smooth interplay of facial movements (Figure 1-1).

Each individual has his own facial wrinkle design, which is determined by the skin's being thrown into folds at right angles to the resultant muscle pull, transmitted to the skin by the superficial fascia. Thus the forehead wrinkles would be at right angles to the line of frontalis muscle contracture and, of course, would run horizontally. Variations would occur by forceful contractures of other muscles about the forehead.

Examination of numerous facial patterns reveals, however, certain prevalent types (Figure 1-2). In regard to the cheeks, one finds individuals with upward-curving horizontal lines that create a "happy face." In contrast, a "sad face" is one in which the wrinkles curve downward. Similarly, two common variations are found in the upper lip and two in the lower lip. From the surgical viewpoint, individual variations must be carefully determined before any incision is made in the face.

As the aging process continues, fat is lost from the subcutaneous tissue, through which the fibrous filaments run from the muscles to the dermis. The thin skin appears to become attached more firmly to the deep muscles. Offering less resistance, it is thrown into deeper and more numerous folds or wrinkles.

THE MUSCLES OF THE FOREHEAD AND EYELIDS

There are tremendous variations in forehead and eyelid movements. Despite the coordinated bilateral action usually seen, it is possible for one side to move independently (Figure 1-3). The orbicularis oculi