ATLAS OF STRABISMUS SURGERY

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line drawings by Craig G. Gosling

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FOREWORD

The principles of strabismus surgery, consisting of weakening the action of an overacting muscle or strengthening the action of an underacting muscle, have remained unchanged for many years. Significant modifications and refinements during the last few decades, however, have enabled the surgeon to deal more effectively with clinical situations in strabismus, many of which were thought to be incurable only a short time ago. For instance, the improved preoperative and intraoperative diagnosis of mechanical factors and their elimination by conjunctival surgery and other means, the increased popularity and proved effectiveness of muscle transposition procedures, the use of plastic materials, the improvement of exposure techniques for surgery on the oblique muscles, and the reintroduction of marginal myotomies are some of the features that have recently received special attention.

Descriptions of these and other modern surgical approaches are scattered widely in the literature and are not readily accessible to most ophthalmologists. This atlas fills a definite void in presenting an up-to-date collection of current surgical techniques and indications for their use.

Dr. Helveston, an experienced strabismus surgeon, is a well-qualified authority on the subject. He has performed an invaluable service in assembling this atlas. The wealth of illustrative material and the accompanying succinct text should make this book indispensable for residents and ophthalmologists in practice. I predict that it will be received enthusiastically by the ophthalmologic community and am proud that it comes from the pen of one of my former students.

Gunter K. von Noorden
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Houston, Texas

PREFACE

There have been several excellent texts on strabismus including strabismus surgery in the past few years, but developments have moved rapidly. Recent advances in technique have greatly expanded the options available to the strabismus surgeon. More accurate diagnostic tests leading to a better understanding of the pathophysiology of strabismus and amblyopia have convinced some surgeons of the need for surgery in infants as young as 5 months of age. Improved anesthesia and an increasing boldness on the part of the strabismus surgeon have led to outpatient extraocular muscle surgery in some instances without patch and without ointment or drops. The limbal and cul-de-sac (or fornix) extraocular muscle exposure techniques have largely superseded the transconjunctival incision in the interpalpebral space among younger surgeons. The retinal surgeon has opened new dimensions in the degree to which sub-Tenon's space may be explored.

New sutures, adhesives, muscle sleeves, and implantation materials have proved useful innovations. Globe fixation sutures, conjunctival recession and relaxation procedures, forced duction and active forced generation tests, as well as topical anesthesia for extraocular muscle surgery, have greatly enlarged the vista of strabismus surgery.

For these reasons it seems appropriate at this time to compile an up-to-date atlas of strabismus surgery. This atlas employs schematic drawings designed to illustrate at each step only that anatomy significant to the step shown for easier orientation of the reader. Procedures that I have found useful have been given emphasis; those that are controversial or that I have not found to be particularly helpful have been omitted. Some "favorite technique" may be omitted simply because I prefer an alternative choice; those that I think should be avoided will be clearly labeled so.

No attempt will be made to give a set of surgical recipes that will result in a predetermined amount of straightening. Instead, general concepts leading

to a philosophy for strabismus surgery will be presented. My intent is that this atlas will be of help to the practicing strabismus surgeon and the resident in ophthalmology by bringing together in one volume many techniques from a variety of sources for quick and easy reference.

Several people who assisted significantly in their own way to make this atlas possible deserve my sincere thanks. Dr. Gunter K. von Noorden, teacher, critic, and friend, introduced me to strabismus and to the pursuit of academic ophthalmology. Craig Gosling worked with industry and imagination on the illustrations, the heart of any atlas. Ken Julian, Susan Argeroplos, and Joe Demma prepared the photographic material. Dr. Fred M. Wilson provided the departmental leadership that made it possible to complete this work. Dr. Merrill Grayson furnished helpful criticism. Bonnie Wilson made the operating room a pleasant place in which to work. My residents and many of my colleagues, in particular Drs. Marshall M. Parks and Phillip Knapp, provided both stimulus and direction. My thanks also to Mrs. Paul Sanders and Pamela L. Payne for typing the manuscript.

Eugene M. Helveston

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CHAPTER ONE

SURGICAL ANATOMY

A clear understanding of the anatomy of the extraocular muscles and of the fascial structures associated with the globe and orbit is a prerequisite to successful strabismus surgery. At the outset, the surgeon must be concerned with the mechanics of access to the operative site between the lids and through the conjunctiva and Tenon's capsule. These last two structures have been redescribed by Lester T. Jones. The location, blood supply, and innervations of each extraocular muscle must be known, as well as the contribution of each muscle's intrinsic blood supply to the nutrition of the anterior segment of the globe. The scleral thickness varies according to location. This must be taken into account when choosing needles to place into the sclera.

THE PALPEBRAL FISSURE

The dimensions of the palpebral opening increase nearly 50% in width and 20% in height between infancy and adulthood. The configuration of the palpebral opening varies with a person's physical and racial characteristics.

PLATE 1-1

A The average adult palpebral opening is 28 mm long and 10 mm high. A solid blade, spring-loaded lid speculum with 18-mm blades effectively holds the lids widely apart to provide ample exposure for extraocular muscle surgery. In performing extraocular muscle surgery, the lids are separated without concern for a slightly increased intraocular pressure; with intraocular surgery, however, increased intraocular pressure *is* a great concern.

B The average 18-month-old child has a palpebral opening that is 20 mm long and 8.5 mm high. A solid blade lid speculum with 8-mm blades is adequate for most children of this age.

C The newborn has a palpebral opening measuring 18 mm long and 8 mm high. A solid blade lid speculum with 6 mm-blades is adequate for the newborn.

The size of the palpebral opening is a significant factor in extraocular muscle surgery technique. A lid speculum appropriate to the size of the palpebral opening should be used. The surgeon should also expect to encounter more difficulty with exposure and suture placement, particularly in medial rectus recession, in patients with a small palpebral fissure or deeply set eyes. However, measured recession can be accomplished even with the smallest lid fissure opening in a 6-month-old child. Limited working area is not an adequate reason for doing a marginal myotomy as an initial weakening procedure of a medial rectus muscle in infantile esotropia, simply because the marginal myotomy is easier to accomplish than a measured recession. Extraocular surgery in an adult with deeply set eyes and a smaller than average palpebral opening can be more difficult than such surgery in a 3- or 4-year-old child with a normal or larger than normal palpebral opening.

Unlike the palpebral opening, which is a significantly different size in adults, infants, and young children, the extraocular muscles are nearly equal in size throughout life. A child with a tiny palpebral opening is likely to have a medial rectus whose insertion is very close to the adult measurements of approximately 10 mm wide. The timing of early surgery is not in any way limited by the size of the palpebral opening or of the extraocular muscles. However, in infantile surgery slightly smaller numbers are used for recession and resection because the globe is slightly smaller. For example, recession of an adult's medial rectus muscle up to 5.0 mm is common, but the limit for recession of the medial rectus of a child under 1 year is 4.0 to 4.5 mm. Similar reductions in the upper limits for recession and resection of the other extraocular muscles should be applied in children under 1 year.

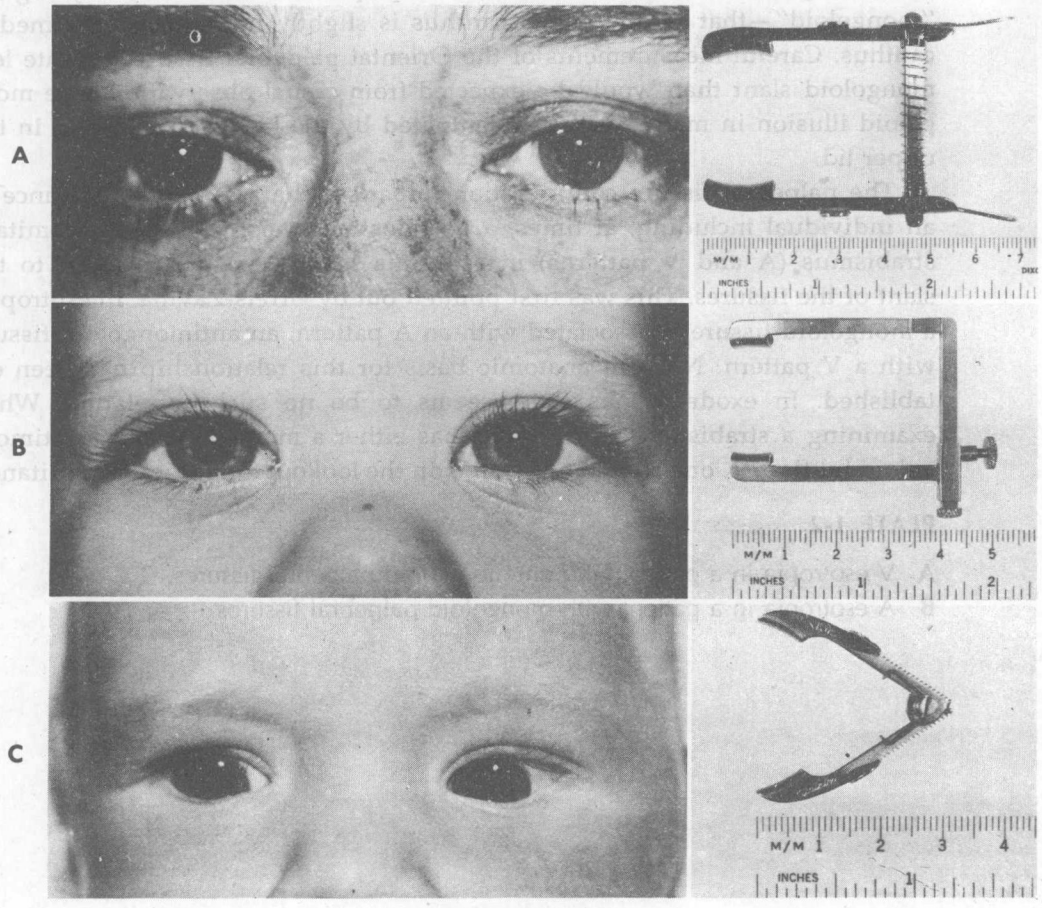

PLATE 1-1

THE PALPEBRAL FISSURE—CONT'D

The palpebral fissure may be level, mongoloid, or antimongoloid, depending on the relative positions of the medial and lateral canthi. If the outer canthus is higher than the inner canthus, a mongoloid palpebral slant exists. If the outer canthus is lower than the inner canthus, an antimongoloid palpebral slant exists. A straightedge held in front of the palpebral fissure connecting the canthi may be used to compare the relative canthal height. The "normal" relative canthal height is dependent upon what is considered normal for a given race. In the Caucasian, the palpebral fissure is usually slightly "mongoloid"—that is, the lateral canthus is slightly higher than the medial canthus. Careful measurements of the Oriental palpebral fissure indicate less mongoloid slant than would be expected from casual observation. The mongoloid illusion in many cases is accentuated by the lack of a skin fold in the upper lid.

The palpebral fissure configuration imparts a characteristic appearance to an individual including, at times, a pseudostrabismus. Vertically incomitant strabismus (A and V patterns) in esotropia follow a pattern related to the slant of the fissures. This was first pointed out by Urrets-Zavilia. In esotropia, a mongoloid fissure is associated with an A pattern, an antimongoloid fissure with a V pattern. No firm anatomic basis for this relationship has been established. In exodeviations there seems to be no such correlation. When examining a strabismus patient who has either a mongoloid or an antimongoloid lid fissure, one should always be on the lookout for vertical incomitance.

PLATE 1-2

A V esotropia in a patient with antimongoloid palpebral fissures.
B A esotropia in a patient with mongoloid palpebral fissures.

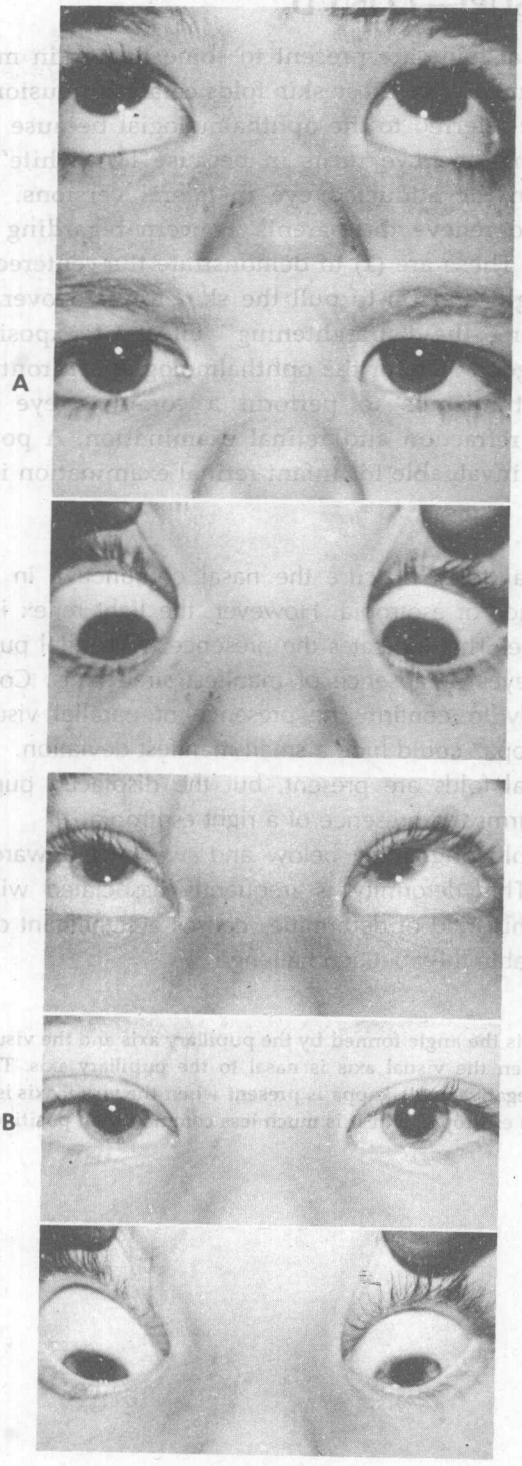

PLATE 1-2

THE PALPEBRAL FISSURE—CONT'D

Epicanthal folds are present to some degree in most children during the first few years of life. These skin folds create an illusion of esotropia, and many children are referred to the ophthalmologist because of this pseudoesotropia. Parents think one eye turns in because no "white" can be seen medially, especially in the adducted eye in lateral versions. Two techniques can be employed to relieve the parents' concern regarding the pseudoesotropia of epicanthus. These are (1) to demonstrate the centered pupillary reflexes with a muscle light and (2) to pull the skin forward over the bridge of the nose, demonstrating the "straightening" effect of exposing medial conjunctiva. It is still a good rule for the ophthalmologist confronted with an obvious case of pseudostrabismus to perform a complete eye examination, including cycloplegic refraction and retinal examination. A portable, indirect ophthalmoscope is invaluable for infant retinal examination in such cases.

PLATE 1-3

A Epicanthal folds obscure the nasal conjunctiva in both patients, giving the appearance of esotropia. However, the light reflex is centered in the pupil in each case. This indicates the presence of parallel pupillary axes and therefore straight eyes or absence of manifest strabismus. Cover testing must be done eventually to confirm the presence of parallel visual axes because a large angle kappa* could hide a small manifest deviation.

B Epicanthal folds are present, but the displaced pupillary reflex in the right eye confirms the presence of a right esotropia.

C A skin fold originating below and sweeping upward is called epicanthus inversus. This deformity is frequently associated with blepharophimosis and ptosis. This triad of deformities causes a significant disfigurement and presents a formidable therapeutic challenge.

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*Angle kappa is the angle formed by the pupillary axis and the visual axis. A positive angle kappa is present when the visual axis is nasal to the pupillary axis. This simulates exotropia and is common. A negative angle kappa is present when the visual axis is temporal to the pupillary axis. This simulates esotropia, and it is much less common than positive angle kappa.

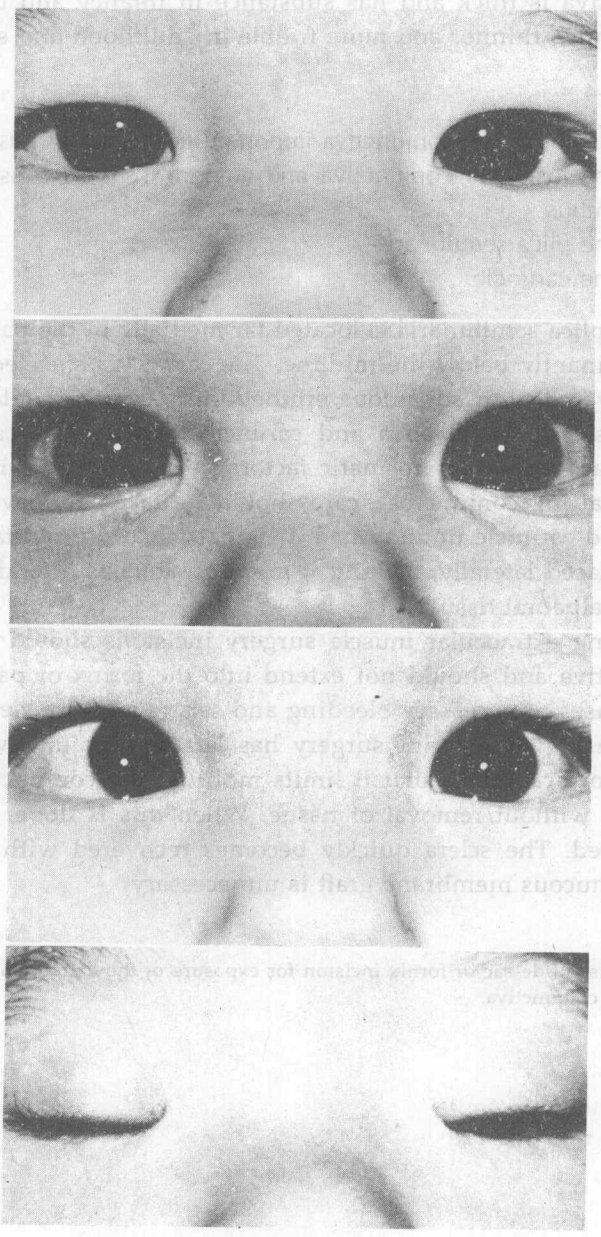

PLATE 1-3

THE CONJUNCTIVA

The bulbar conjunctiva loosely covers the anterior part of the globe from the fornices above and below and from the canthi medially and laterally. It becomes fused with anterior Tenon's capsule and the sclera at the limbus. The conjunctiva is thick and has substance in infancy and childhood, but it becomes much thinner and more friable in adulthood and senility.

PLATE 1-4

Landmarks of the conjunctiva important to the strabismus surgeon are:

1. The fusion of conjunctiva and anterior Tenon's capsule with sclera at the limbus
2. The plica semilunaris
3. The caruncle

The plica semilunaris is located far medially in the palpebral fissure and is predominantly below the midline. The caruncle is located medial to the plica. It is covered with squamous epithelium and often contains small hairs. The relationships of the plica and caruncle to each other and to the palpebral fissure are important cosmetic factors in strabismus surgery. When incising and repairing conjunctiva, care should be taken to leave the position of the plica and caruncle undisturbed. It is particularly important that the plica not be displaced laterally, making it more obvious as a reddened unsightly mass in the palpebral fissure.

During extraocular muscle surgery incisions should be limited to bulbar conjunctiva and should not extend into the fornix or palpebral conjunctiva.* This causes unnecessary bleeding and serves no purpose.

In cases where prior surgery has left the conjunctiva reddened and unsightly or scarred so that it limits motility, the conjunctiva may be recessed with or without removal of tissue. When this is done, sclera should be left uncovered. The sclera quickly becomes recovered with epithelium, and the use of mucous membrane graft is unnecessary.

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*The Parks cul-de-sac or fornix incision for exposure of the extraocular muscles is actually made in bulbar conjunctiva.