Practical Facial Reconstruction

THEORY AND PRACTICE

Andrew J. Kaufman

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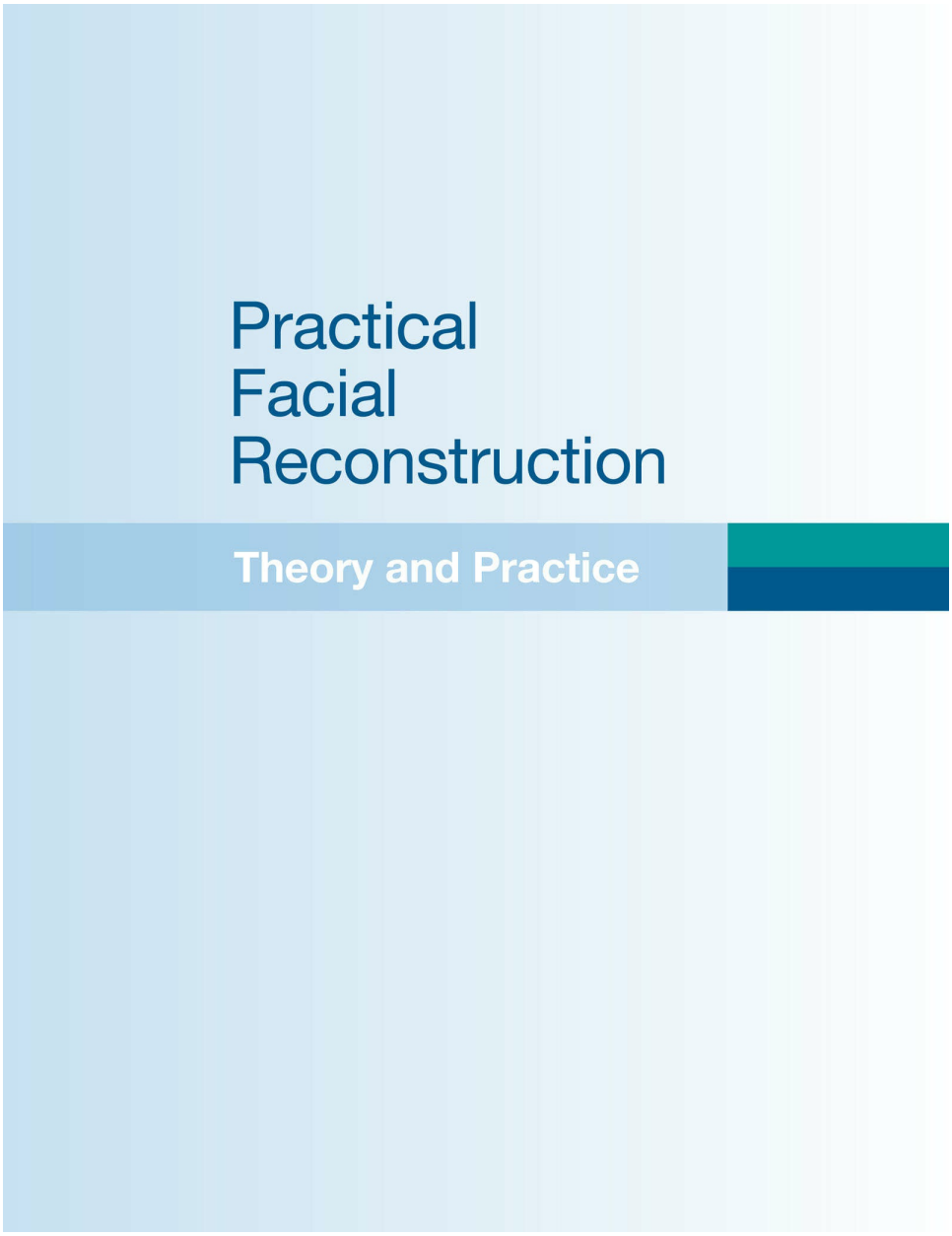
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Dedication

To my mother, short on this earth but forever in my heart and soul;

To my father, an ideal role model as physician, father, and friend;

To my brother Bobby, a hero and the embodiment of strength and bravery;

To my wife, Jayme, for her love and support, and my children, Madeline and Ethan, for whom I wish a world of love, happiness, and peace;

And to my patients, who have provided the trust, respect, and gratitude that make the subject of this book so rewarding.

Foreword

I write this foreword to *Practical Facial Reconstruction, Theory and Practice* to introduce this topic and encourage readers to study and enjoy the contents from beginning to the end. Andrew Kaufman is a talented and experienced surgeon with a long history of teaching experience to residents, fellows, and established physicians locally, nationally, and internationally. He is a premier surgeon and a leader in facial reconstruction and has contributed a great deal to our specialty. His knowledge and experience through this book adds significantly to the teaching of facial reconstruction. It is a masterpiece and should be studied by students and established physicians of all specialties involved in facial reconstruction. It is more than an atlas or a textbook. In this book, Dr. Kaufman's style is to present the rationale for a given reconstruction that teaches the reader the thought process for the choice of repair. He shows what tissue is missing, explains where to harvest available replacement tissue, and then demonstrates the most efficient way to move it. Next, he gives the pearls, tips, and important smaller details that allow the reader to take this knowledge into the operating suite and obtain the best results. The photographs are of high quality, and the drawings add significantly to the teaching and to the understanding by the reader. The summary pearls are helpful when browsing and to remember the important points of each repair. The book can be read slowly for detailed learning or used to browse for new tips and ideas. This is a book for everyone interested in facial reconstruction, including dermatologists, plastic surgeons, otolaryngologists, and general surgeons. It will be a valuable text for students and a resource for any experienced surgeon looking for ideas for complex cases. Dr. Kaufman's experience highlights beautiful results and gives the reader principles that will enhance any surgeon's surgical skills with repeatable and reliable outcomes.

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Preface

Facial reconstruction can be one of the most rewarding aspects of medicine. Taking a surgical defect or traumatic wound and creating a result that preserves function and restores appearance is tremendously satisfying not only to the patient but also to the surgeon. This is one characteristic of reconstructive surgery that has drawn physicians from varied specialties to study, practice, and excel at facial repair. Reconstruction of the face not only restores a patient's public appearance but also impacts his or her public persona and personal self-image. This degree of importance is evident in the initial consultation when a patient may voice concerns about the surgery and the resultant scar and is equally conspicuous in the patient's gratitude and kindness at the postoperative visit when viewing and discussing the final result.

To be successful, a repair must accomplish both aesthetic and functional goals. A nasal repair that looks flawless but decreases air flow because of impairment of the internal nasal valve is not a complete success. Similarly, repair of the eyelid that provides protection of the globe and avoids ectropion but leaves an unsightly scar across a cosmetic unit is also not completely successful. Both aesthetic and functional goals should be met for "success," but sometimes it is not possible to completely reach those goals in one surgical procedure. The functional goals should be addressed and achieved in the planning and primary surgical procedure whenever possible. However, sometimes the ultimate cosmetic goals may require additional procedures to "soften" or "fine-tune" the final cosmetic result through scar abrasion, scar revision, intralesional steroids, or lasers.

There are several excellent textbooks available that detail facial reconstruction, covering both the principles and designs of repairs and regional approaches to repairs. What I try to do in this book is describe a complementary approach to repair that focuses on teaching a **practical** way to evaluate a surgical defect, analyze it, and design and execute a repair that works best for that defect in that location for that patient. Rather than memorize particular types of repairs for particular locations, master

an approach to facial repair that inspires creativity and adaptability. As such, this book is not meant as a primer on basic facial repair, but instead complements other more comprehensive textbooks as a readable and practical approach to enhancing one's expertise at facial reconstruction. A reader will benefit most from having at least a basic understanding of facial anatomy, surgical technique, and biomechanics.

My second goal is to attempt to simplify or demystify some useful reconstructive techniques. Having taught residents and fellows and lectured on reconstruction for many years, I have been impressed that some very useful repairs are quite intimidating to many surgeons. Some of this may be attributable to lack of experience in performing the repair or perhaps to gaps in their reconstructive education. Some of it may be explained by the complex geometry in designing the repair and the potential downside to miscalculation or improper execution. I have tried to elucidate the exact points in design and execution of these repairs that simplify them and help to guarantee success. And for the seemingly more complicated repairs (e.g., bilobed transposition flaps, helical rim advancement flaps), I have provided an almost formulaic description as well as artistic illustrations that help to demonstrate key principles for completing that reconstruction.

Each defect is slightly different; each repair is unique. My ultimate goal is to make the reader think, preferring not to espouse a particular repair for a particular defect, but to enhance flexibility and ingenuity. These characteristics distinguish an innovative surgeon and ultimately elevate the care you provide your patient.

Andrew J. Kaufman, MD, FACP

Acknowledgments

Special thanks to Timothy C. Hengst, FAMI, CMI, an amazingly talented, respected, and patient medical illustrator, who helped me to explain some key principles in this book.

Special thanks also to John A. Zitelli, MD, for agreeing to write the Foreward in this book. Dr. Zitelli has been a friend and a source of inspiration, and his lectures and published articles are a valuable resource to those interested in understanding reconstructive surgery.

Special thanks also to the front office, back office, and nursing staff who have worked with me through the years and who help make my surgeries easier to accomplish and my life easier to enjoy.

HISTORICAL NOTE: MOULAGE OF FOREHEAD FLAP

(Moulage from author's collection. Image previously published in Kaufman A. J. Moulage: The forehead flap. *Dermatol Surg* 2003;29:402.)

Moulages were wax models created by artisans during the 18th and 19th centuries within Europe and America as clinical teaching models to

convey the three-dimensional, life-size appearance of disease processes as well as surgical procedures. The moulage shown here from the latter part of the 19th century depicts the Forehead Flap, also previously referred to as the “Indian Rhinoplasty.”

The origin of the forehead flap dates to the 6th century BC., when it was described in an ancient Sanskrit text on medicine and surgery, the Sushruta *Samhita*. A caste of potters or brickmakers in India developed the forehead flap as well as a cheek flap for nasal reconstruction. With the translation of the *Samhita* in Sicily during the 15th century, surgeons like Branca de Branca and his son, Antonius, embraced the new technique and added more sites of donor tissue (e.g., arm) as well as recipient repair sites (e.g., lips and ear). Gaspare Tagliacozzi further improved upon surgical reconstruction techniques for nasal reconstruction, in particular, the use of the arm for donor tissue (later referred to as the “Italian Method” of rhinoplasty) and published his treatise, *De Curtorum Chirurgia per Insitionem*, in 1597. Although Tagliacozzi’s text was popular among surgeons, religious and political views disapproved of the concept of changing one’s appearance even for reconstructive purposes, and it was not until 1794 that the surgical technique reached an English-speaking audience. A Letter to the Editor in *Gentleman’s Magazine* described the Indian Forehead Flap in the reconstruction of the nose of a bullock driver for the English army whose nose and one hand were amputated while he was a prisoner of Tippoo Sultan. Twenty-two years later, an English surgeon, J.C. Carpue, described his use of the technique in an account of the reconstruction of the noses of two army officers. Over the remainder of the 19th century, many more forehead flaps and various iterations of the forehead flap were performed, but it was not until the latter part of the 20th century when the full utility of this interpolation flap was appreciated. Now, subtleties in design and execution as well as the need for structural support and restoration of nasal lining make the paramedian forehead flap an important technique for repair of larger nasal defects, and its history a key turning point in facial reconstruction.

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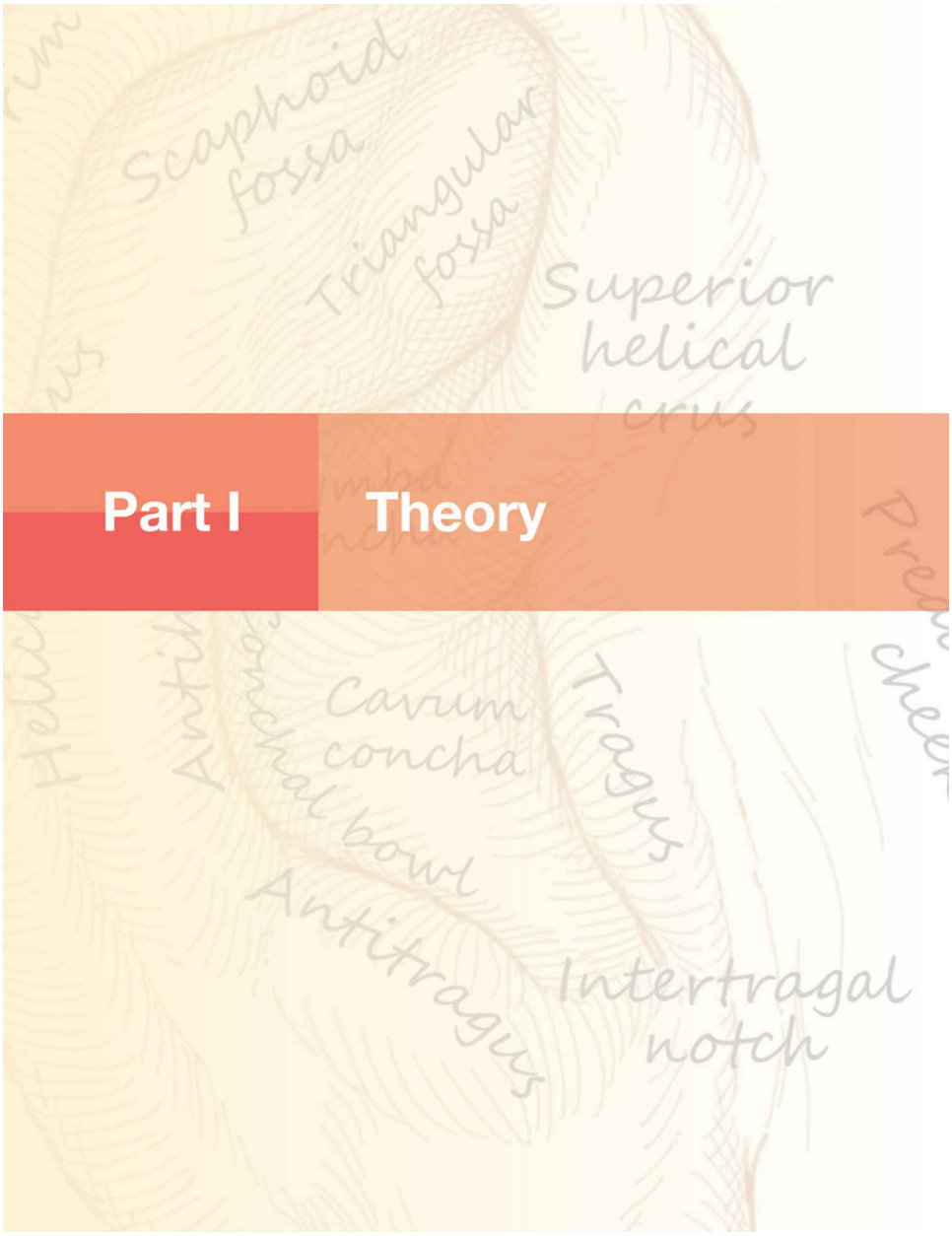

Part I Theory

1 Principles, Design, Completion

1.1 PRINCIPLES OF RECONSTRUCTION

The first step in cancer surgery is to ensure clearance of the tumor. Neither cosmetic nor functional goals can be met if the results are short-term, and the patient will require further surgery to remove persistent tumor. Taking too narrow a surgical margin or leaving positive surgical margins untreated will likely doom the patient to more extensive cancer surgery and reconstruction in the future. Although adjuvant radiation therapy may help "clean up" some residual tumor cells in some situations, a better, more consistent option may be to consider Mohs micrographic surgery as a primary method to clear difficult or recurrent skin cancers before reconstructive surgery.

Mohs surgery was first described in the 1930s by Dr. Frederic Mohs. At that time, the procedure was described as "chemosurgery" in reference to the zinc chloride paste that was applied to the tumor prior to surgery. This process fixed the tissue "in situ," and although it made surgical excision of the tumor easier in some ways, it made immediate postoperative reconstruction of this devitalized wound bed impossible. Although Dr. Mohs did perform the procedure without zinc chloride paste in certain locations such as the eyelids, several other physicians began utilizing Mohs surgery without zinc chloride paste in the 1970s, a procedure subsequently referred to as "fresh tissue technique." Today, almost every case of Mohs surgery is performed without the tissue fixative, and the procedure is termed Mohs micrographic surgery. The two greatest benefits of the procedure are that it provides the highest cure rate for most primary and recurrent skin cancers and preserves the greatest amount of healthy tissue around the tumor site. Even if another surgeon will be performing the reconstruction, it may be in the patient's best interest to have the tumor removed by Mohs surgery. And for the surgeon performing the reconstruction, the benefits of highest cure rate (i.e., less chance of performing another excision and repair in this area) and greatest preservation of healthy tissue (i.e., more healthy adjacent tissue means

more options for local flap or side-to-side repair) should sound like a good option.

After cancer removal, we address the two goals in reconstruction: functional and aesthetic. Both of these should be addressed in consultation with the patient, and one should get a sense of whether one's ability and goals will match the patient's expectations. (See also Section 1.3.) As mentioned before, selection and performance of reconstructive technique needs to address functional as well as aesthetic requirements. Functional requirements may include the eyelids' protection of the globe, the lips' retention of food and liquids, the ears' collection of sound, and the nostrils' movement of symmetric and uninterrupted air flow. Each of these functional requirements can be disturbed by a poorly planned or executed reconstruction. A suboptimal aesthetic result can more easily be addressed in a subsequent or revision surgery; however, the preference is to reach both goals first time around.

In considering **any** defect for reconstruction, **three questions** should be considered:

1. What is missing?
2. Where am I going to find the replacement tissue?
3. How am I going to get it there and hide most of the subsequent scars?

Let us examine each of these.

"What is missing?" Each defect is different. Does the defect involve only skin and soft tissue, or is structural integrity also missing? If only skin and soft tissue, is it superficial or deep? Is it in an area where second intention healing may provide excellent results? Many defects in concave areas heal quite well through proper wound care and the body's own innate mechanism of wound repair. As a result, many defects of the conchal bowl may best be treated by good wound care and second intention healing (Section 7.4). Defects on the temple too large to easily repair with a side-to-side or flap repair can also be allowed to heal by second intention healing (Section 4.8). Superficial defects on the medial canthus (especially if balanced above and below the medial canthal tendon and not adjacent to the lid margin) and superficial defects on concave areas of the nose (e.g., alar crease) can also be allowed to heal by second intention healing with exceptional results.

Now, if the defect is deeper or impacts structural support or is on a convex surface or crosses into another cosmetic unit or subunit, one should consider other options. Deeper defects, especially if near a free margin (e.g., eyelid or vermilion border) or anatomical landmark (e.g., eyebrow or nasal tip), should be repaired to minimize scar contraction and thereby minimize the risk of deviation of the free margin or landmark. So although large defects on the temple can be allowed to heal by second intention healing with exceptional results, if that defect approaches the lateral canthus or the tail of the eyebrow, a repair should be considered to minimize the risk of distortion of the lateral canthus or eyebrow. In these instances, it might be worth the extra time and work to place a full-thickness or split-thickness skin graft on the temple defect because the graft will decrease the chance of wound contraction and subsequent distortion (Section 8.6F–H).

If the defect involves structure or if contraction of the wound might compromise function, one should consider structural support via cartilaginous grafting. Most surgeons agree that if structural support is missing (e.g., nasal tip) or if there is a possibility of impairment of function (e.g., over the internal or external nasal valves), then one should replace or restore the structural integrity of the anatomy. Similarly, when nasal mucosa is missing, it should be replaced because although small full-thickness nasal defects may heal without complication, larger defects repaired without mucosal replacement may heal with significant contraction and distortion. In fact, the earliest midline forehead flaps (see image of moulage of forehead flap in front matter of book) were often fraught with this complication, and it was not until various methods to address the missing nasal mucosa and structural support were developed that the aesthetic utility of this flap for complicated nasal repair was truly recognized.

So, if superficial, consider second intention healing, especially on a concave surface away from free margins and anatomical landmarks. If deeper, consider reconstruction of some method. If there is a specific cosmetic or functional quality to the missing tissue, such as the hair-bearing eyebrows or lining of the nasal vestibule, replace with tissue of similar characteristic (Section 4.2). And if structure is missing or structural support is needed to decrease the chance of functional or aesthetic distortion, reconstruct the structure or add adequate support to avoid distortion.

The second question is “Where are you going to find the replacement tissue?” The tissue with the greatest similarity to the missing skin of the defect (i.e., color, texture, thickness, adnexal structures, actinic damage) is tissue from the *same* cosmetic subunit adjacent to the defect. Unfortunately, tissue within the same cosmetic subunit is frequently inadequate for reconstruction, but the tissue with the second greatest similarity to the tissue being replaced is probably within an *adjacent* cosmetic subunit. This similarity allows local flaps to be an excellent reconstructive option in repair of defects on cosmetically sensitive areas. Tissue of similar color, texture, and thickness is being used to repair the defect. As a result, local flaps tend to be a superior reconstructive option compared with grafts for repair of these areas. This is especially true over convex areas (e.g., nasal tip) or deeper defects, where grafts cannot reconstruct the depth of the wound but only its surface. In cases where the defect is too large for repair with a local flap, you might have to go to another cosmetic unit to find the replacement tissue. For large or deep or complicated defects on the nasal tip, this might be the forehead, where a paramedian forehead flap might be the best alternative (e.g., Section 5.12). For a similar complex defect on the nasal ala or soft triangle of the nasal tip, one might consider a cheek-to-nose interpolation flap from the medial cheek (Section 5.11). Both the forehead and the cheek have similar characteristics to the skin of the distal one-third of the nose and are excellent sites for replacement tissue. If the defect is superficial but too big for local flap repair, another alternative is a full-thickness skin graft. Although the usual donor site may be the pre- or postauricular skin or the supraclavicular area (Section 4.4), an alternative is to use adjacent tissue for the skin graft, a procedure that has been referred to as an adjacent-tissue skin graft or a Burows’ graft. In this instance, tissue adjacent to the surgical defect is used as a donor site for the full-thickness skin graft. This may be particularly useful in defects that extend beyond one cosmetic unit or subunit into another. In these cases, one closes the defect in individual cosmetic units or subunits and in doing so, creates redundant tissue that is used to repair the remaining surgical defect (Section 8.6).

Finally, we have to ask, “How are you going to move the needed tissue from where it is located to where you need it?” The trick here is to accomplish this feat without distortion of anatomical landmarks or free margins and hide incision lines (and thus subsequent scars) as well as possible. To avoid the former, proper design of the side-to-side or flap repair is essential to avoid **secondary tension vectors** (i.e., tension caused

by execution of the repair), which could distort nearby free margins or landmarks. For the latter, consider placement of incision lines within rhytides, furrows, or the junctions between cosmetic units or subunits. It is likely that these two factors discourage less experienced reconstructive surgeons from considering local flap repairs. It is much easier to place a full-thickness skin graft on a surgical defect than to worry about secondary tension vectors or hiding incision lines even if a local flap will provide a more similar skin surface and reconstruct depth as well.

So, if each defect is approached in the same logical, step-by-step manner, the reconstructive process becomes **easier** and **adaptable** to different situations. Rather than trying to remember a specific repair for a specific site, it is more useful and versatile to consider the following questions: what is missing, where are you going to find its replacement, and how are you going to get it there?

1.2 ANATOMICAL CONSIDERATIONS

When considering facial reconstruction, certain anatomic considerations become critical. The reconstructive surgeon needs to understand cosmetic units and subunits and what defines the structures that he or she is trying to reconstruct. This requires an understanding of the biomechanical features of skin and of basic geometry. It is also important to have a thorough knowledge of facial anatomy, including neurovascular and other structures, and where these nerves, blood vessels, ducts, etc., are most like to be in jeopardy.

As mentioned previously, when considering facial reconstruction, one should remember that concave areas frequently heal very well when allowed to heal by second intention healing. Second intention healing should therefore be considered as a possibility in the concave areas of the temple, ear, nose, and medial canthus. Frequently, one would be hard-pressed to perform a repair in these areas that produces a better cosmetic result than that performed by Mother Nature (Sections 4.8 and 7.4).

Another consideration is to place incision lines where they will be least noticed when healed. **Relaxed skin tension lines (RSTL)** are most obvious as rhytides, wrinkles, or furrows and tend to run perpendicular to the underlying musculature in the area **(Fig. 1.1)**. In some areas and in some patients, RSTL are obvious; in others, they are less so, and the

surgeon needs to plan incisions and closures where RSTL would be anticipated (e.g., young patients without rhytides). Another location where incisions and the healed scars are well hidden is at the junction of cosmetic units or even the junction of cosmetic subunits. In these areas, the subtle nuances in light and shadow or changes in color or texture tend to hide incisions well.

Defects that cross from one cosmetic unit to another, such as from the nose to the cheek, should be considered for repair by more than one repair. A flap that bridges two cosmetic units is usually more noticeable than two flaps or a side-to-side repair combined with another repair (e.g., flap or graft) that reconstructs the two cosmetic units separately. The human eye and brain more easily detect subtle changes in facial topography and asymmetry. It is much better to maintain symmetry and the expected convexities and concavities that distinguish cosmetic units than to try to repair a multiunit surgical defect with just one repair.

In a related manner, distortion of anatomical landmarks or free margins must be avoided at all costs. **Anatomical landmarks** are conspicuous anatomical features that define the characteristics of the cosmetic unit or subunit. These include obvious landmarks such as the nasal tip and philtrum of the upper lip but also less obvious structures such as the eyebrow or melolabial furrow. Distortion of these landmarks is apparent because they occupy a central prominent facial location, because they define the features of the cosmetic unit, or because they are paired with another structure and any change in one causes obvious facial asymmetry. **Free margins** include the eyelid margin, alar rim, and lip margin. These free edges are more susceptible to distortion because at least in one direction, they are not tethered or secured.

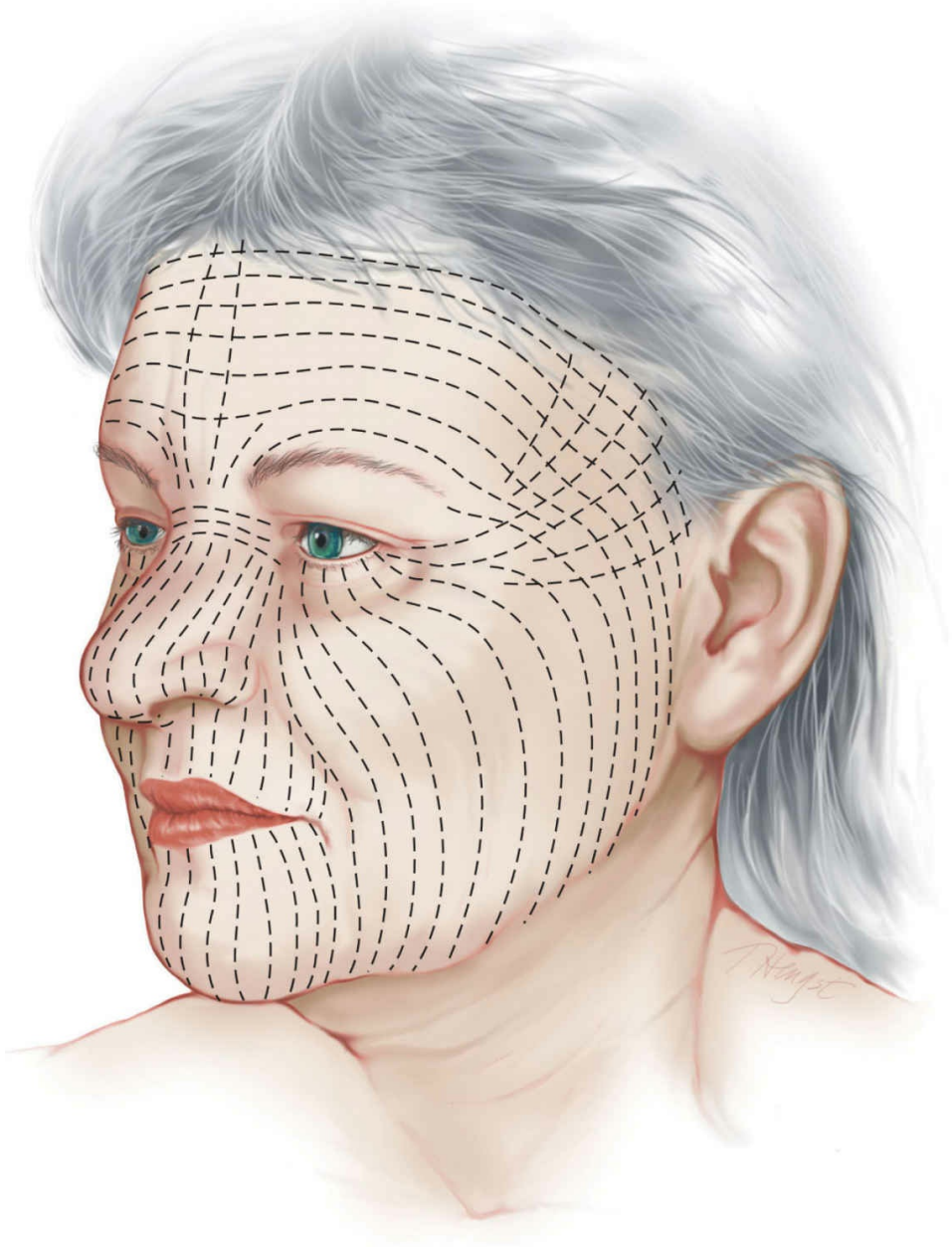

Figure 1.1. Relaxed skin tension lines tend to run perpendicular to underlying musculature and fall within real or anticipated rhytides or furrows or at the junction of cosmetic units. At some locations, such as the temple–forehead junction or central forehead, relaxed skin tension lines may be more ambiguous. In those locations, pinching of the skin to determine the greatest laxity may be helpful, as well as considering the location of nearby adjacent free margins and anatomical landmarks. In addition, as incisions approach free margins such as the eyelid, alar rim, and vermilion border, the direction of the incision should become more perpendicular to the margin to avoid distortion of the free margin.

When a surgical defect is closed in a side-to-side fashion, tissue redundancy may develop at the poles of the incision. This redundancy may be long-lasting and is usually resolved with the excision of a “dog ear.”

Excision of **dog ears** (also referred to as **tricones** or **standing cones**) involves the removal of excessive tissue and placement of the incision within a favorable location, such as RSTL or the junction of cosmetic units or subunits. In advancement flaps, dog-ear excisions can be placed at the base of the pedicle or along the length of the incision line, breaking up an incision line and making it less noticeable. Excision of tricones in advancement flaps also facilitates movement of the flaps by decreasing restraining forces on movement into the surgical defect. Transposition and rotation flaps may develop dog ears at the point of rotation or transposition. In these instances, the dog-ear excision should angle away from the flap pedicle to avoid jeopardizing the blood supply to the flap.

Most of the local flaps described in this book with the exception of the paramedian forehead flap are **random pattern flaps**. They are not based on the blood supply of a single named vessel, but rather by the rich subdermal plexus that runs horizontally through the subcutaneous tissue just deep to the reticular dermis. **Axial pattern flaps** such as the paramedian forehead flap are dependent upon proper design and execution to include the named artery, but when properly performed, they provide a large well-vascularized flap for reconstruction.

For defects that extend to underlying bone or cartilage, a well-vascularized flap may be necessary for satisfactory wound healing. This is particularly true for defects where the periosteum or perichondrium is missing. In these cases, grafts frequently will not survive, and second intention healing may be significantly delayed or unsuccessful. However, with proper wound care, many significant surgical defects with exposed cartilage or bone (but intact perichondrium or periosteum) will develop granulation tissue and ultimately heal. One key requirement is patient education and proper wound care (see Section 1.7). Still, the best option for reliable and rapid wound healing on a wound with exposed or missing periosteum or perichondrium is to cover the wound with well-vascularized tissue (i.e., flap or side-to-side repair).

1.3 PATIENT CONSIDERATIONS

One of the most important elements of successful reconstruction is providing proper informed consent. The patient needs to be aware of the techniques, risks, benefits, and alternatives to treatment, and some patients may require a fairly long and detailed discussion about what their options