4 Operations on the Conjunctiva

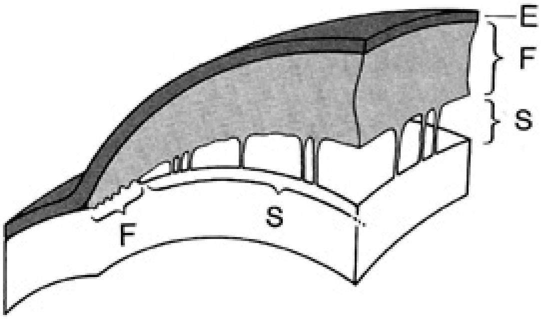

Fig. 4.1. **Surgical anatomy of the conjunctiva.** *E* The superficial epithelial lamella is continuous with the corneal epithelium. *F* The subepithelial fibrous layer extends as far as the limbus. *S* The episcleral space terminates a short distance from the limbus

4.1 General Problems of Surgical Technique

From a surgical standpoint, the conjunctiva is composed of three layers: the *epithelial layer*, consisting of epithelial cells and a thin supporting layer of connective tissue; a *subepithelial fibrous layer*; and the *episcleral space* (Fig. 4.1).

The **epithelial layer** is closely interwoven with the underlying fibrous layer and presents as a separate layer only when dissected. It is then found to be compliant but of low resiliency, tending to retain any position assumed. The dissected epithelium then also displays its extensive surface area, which is necessary to follow the excursions of the eyeball (Fig. 4.2). Ordinarily the true extent of the epithelium is not apparent due to the constricting effect of the **subepithelial fibers**. Unlike the epithelium, these fibers are resilient and can keep the redundant epithelium from crimping during ocular movements.

Directly adjacent to the globe is the **episcleral space**, which contains a network of fibers loosely connected to the sclera. This space allows for motion of the conjunctiva relative to the scleral surface. About 1–2 mm from the corneal margin the episcleral space terminates at the *perilimbal zone*, where the conjunctiva is connected directly and firmly to the sclera (Fig. 4.3).

With regard to *surgical technique*, it is useful to distinguish *mobile zones* where the conjunctiva is freely movable from *fixation zones* where the conjunctiva is firmly adherent to the sclera (e.g., at the limbus or at scars). Because the tissue can evade cutting edges in the **mo-**

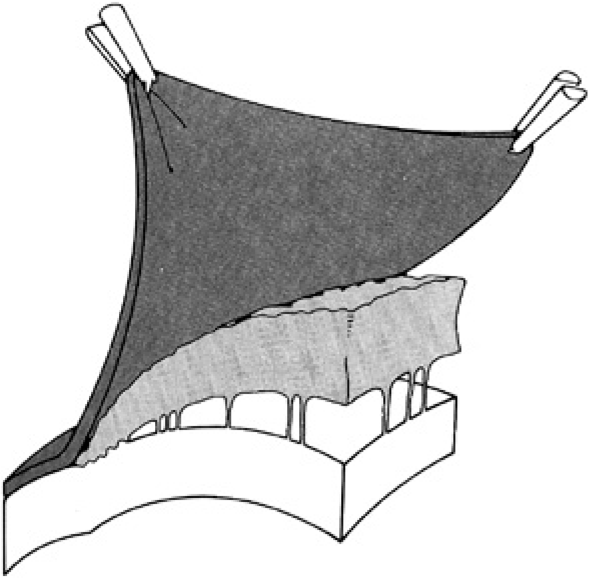

Fig. 4.2. **Separating the epithelial lamella from the subepithelial fibrous layer (dissection of large sliding flaps).** When dissected from the contractile fibrous layer, the epithelial lamella can be expanded to its full size

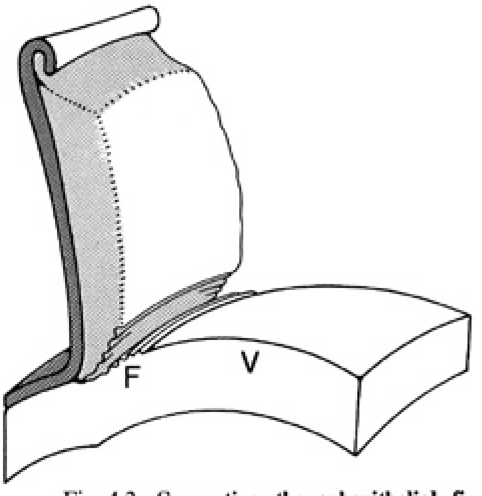

Fig. 4.3. **Separating the subepithelial fibrous layer from the sclera (exposure of the globe surface).** After the loose connective fibers in the episcleral space (*V*) are detached and the perilimbal fibrous zone (*F*) is divided, the conjunctiva can be elevated to expose the sclera. The conjunctival flap may contract according to the elasticity of the subepithelial fibers

bile zones, its *sectility* is *low*, and it is difficult to dissect these zones with much precision. On the other hand, the low sectility is an important safety factor in that it protects the delicate conjunctival tissue from inadvertent injury. This protection is lacking in **fixation zones**. The closer manipulations are carried to these sites, the greater the danger of inadvertent injury, and the greater the caution that must be exercised when performing the manipulations.

In conjunctival **incisions** the shape and position of the cut are determined by the *shifting tendencies of compliant, resilient tissue* described earlier (see Figs. 2.62–2.64). The *direction* of the incision line (in cuts made perpendicular to the tissue surface) is affected by the *fixation zones at the limbus*, at *scars*, and at *immobilizing instruments* (Fig. 4.4). A cutting edge tends to push the tissue in the direction of these fixation zones, and the resulting incision progressively deviates away from the zones.

Fixation zones that affect the *depth* of the dissected layer (in dissections parallel to the tissue surface) are sites where the subepithelial fibers attach to the epithelium and to the sclera. The stronger fixation at a given location determines the *direction in which the cut tends to deviate*. Thus, the scleral attachment is stronger in the region of the *perilimbal zone*, so the cut tends to deviate toward the surface (Fig. 4.5–1). A downward deviation tends to occur over the *episcleral space*, where the fiber attachment to the globe is so tenuous that the epithelial fixation predominates. This tendency becomes more pronounced toward the *fornix*, where there is no deep fixation at all (Fig. 4.5–3).

When the conjunctiva is **grasped** and stretched with a forceps, the tissue is both *deformed* and *displaced*. If it is incised in this condition, the incision will acquire a different shape and position when the tissue is released (see Fig. 2.64). Thus, the special properties of compliant, resilient tissue must be taken into account in grasping as well as cutting.

Dissection of the conjunctiva may be performed on a superficial or deep plane. In *superficial dissection* the epithelium is separated from the resilient subepithelial tissue. This yields large *sliding flaps* (Fig. 4.2) that can be used to repair defects in the conjunctiva or superficial corneal layers (epithelial transposition). *Deep dissection* exposes the episcleral space and gives *access* to the sclera, the adnexa, and the interior of the eye (Fig. 4.3). The desired plane is approached *from the limbus* to obtain fornix-based flaps or from the *epibulbar zone* to obtain limbus-based flaps (Figs. 4.6–4.8).

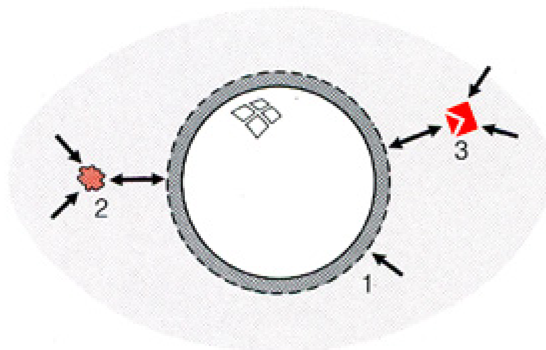

Fig. 4.4. **Shifting tendencies of conjunctival tissue**. During cutting, free conjunctiva shows a lateral shifting tendency like that of tissue fixed on one side (see Fig. 2.63). Thus, it shifts toward the fixation zone at the limbus (*1*), toward scars (*2*), and toward fixating instruments (*3*) (i.e., the resulting incision deviates from those fixation sites). Conjunctiva between two fixation zones shows a forward shifting tendency like that of tissue with bilateral fixation (see Fig. 2.62)

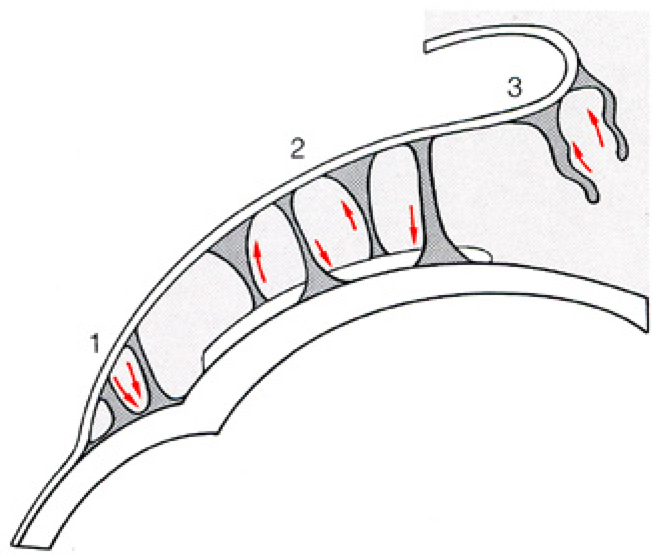

Fig. 4.5. **Shifting tendencies of the subepithelial fibers**. Fibers in the perilimbal zone (*1*) have a stronger attachment to the sclera than to the epithelial lamella, so they tend to shift toward the sclera in front of the blade. In the epibulbar region (*2*) fixation in either area may predominate, so the shifting tendency may be either toward the surface or toward the sclera. As the fornix is approached (*3*), the fibers lose their deep anatomic fixation and tend to shift away from the globe when exposed to a cutting edge

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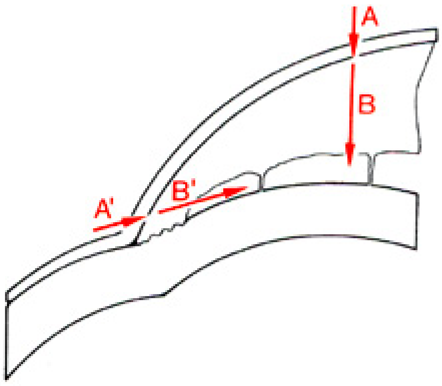
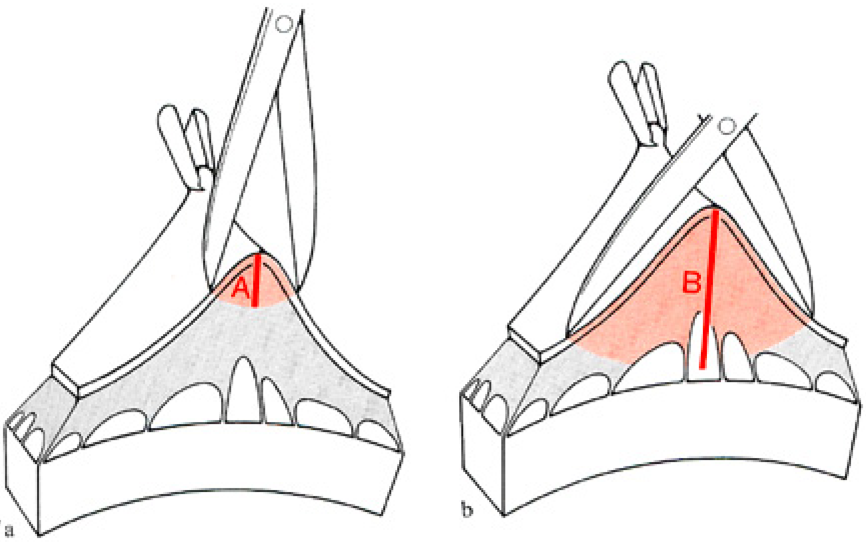


4.6

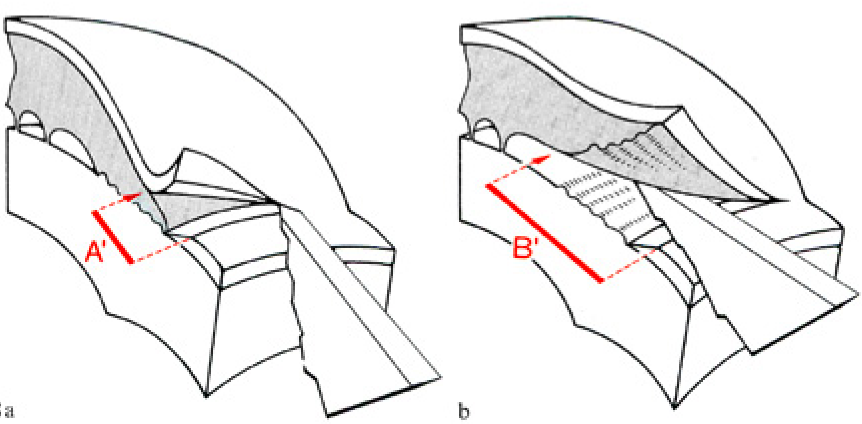
4.2 Episcleral Dissection ("Deep Dissection")

The episcleral space behaves as a *potential space*, which differs markedly from the over- and underlying layers in its loose consistency and so is readily accessible to *blunt* dissection. It can even be defined by fluid injection, and this provides a simple means of identifying the space in confusing situations (e.g., when the anatomy is obscured by scars) (Fig. 4.17b).

A **fornix-based** flap is developed by incising the conjunctiva at the limbus, defining the episcleral space, and undermining the flap toward the fornix. If an attempt is made to cut *from the cornea* in a centrifugal direction (Fig. 4.8), superficial deviation of the incision will tend to occur along the fibers in the firm perilimbal zone, and entry into the episcleral space may prove difficult. Access is made easier by preliminary infiltration of the episcleral



4.7 a b



4.8 a b

Fig. 4.6. **Approaches to the deeper tissue layers**. Over the sclera, the conjunctival layers are incised perpendicular to the globe (*A*, *B*). In the approach from the limbus, the desired depth is reached by dissecting parallel to the sclera (*A'*, *B'*)

Fig. 4.7. **Incising the conjunctiva from its surface**. The placement of the blade tips determines the depth of the incision.

a If only the most superficial layer is to be divided, the tips are placed close to the apex of the fold.

b Placing the tips farther from the apex yields a deeper incision that may enter the episcleral space (*A*, *B*, see Fig. 4.6)

Fig. 4.8. **Incising the conjunctiva from the limbus**. The distance of the blade tip from the limbus determines the depth of the incision.

a If the blade tip is passed close to the limbus, only subepithelial fibers are cut.

b If the tip is more than 2–3 mm from the limbus, the episcleral space is entered (*A'*, *B'*, see Fig. 4.6)

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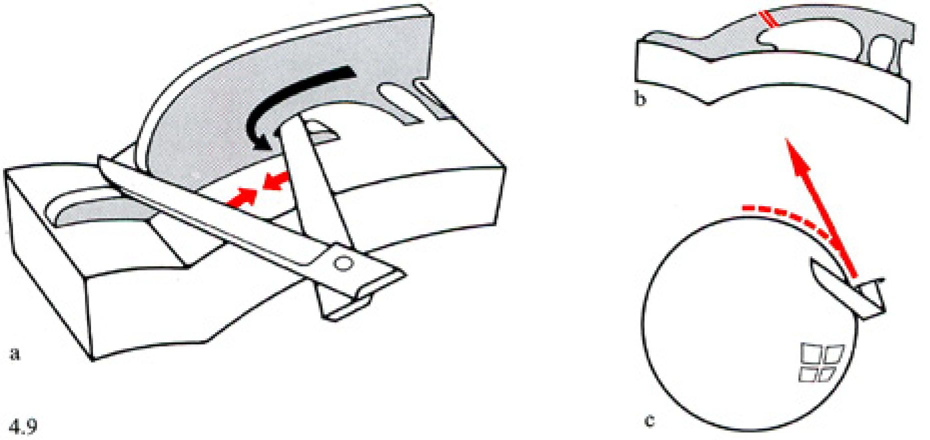

Fig. 4.9. **Effects of lateral shifting tendency in the dissection of a fornix-based conjunctival flap**

a One scissor blade is over the cornea, the other has been passed into the episcleral space through an incision. On closure of the scissors, the loose conjunctival tissue shifts across the cutting edge of the blade toward the perilimbal fixation zone.

b This causes a rim of conjunctival tissue to be left on the limbus upon completion of the cut.

c The cut tends to deviate from the limbus progressively, so the rim becomes wider as the cut proceeds. *Broken line*: planned direction of cut. *Arrow*: actual direction of cut

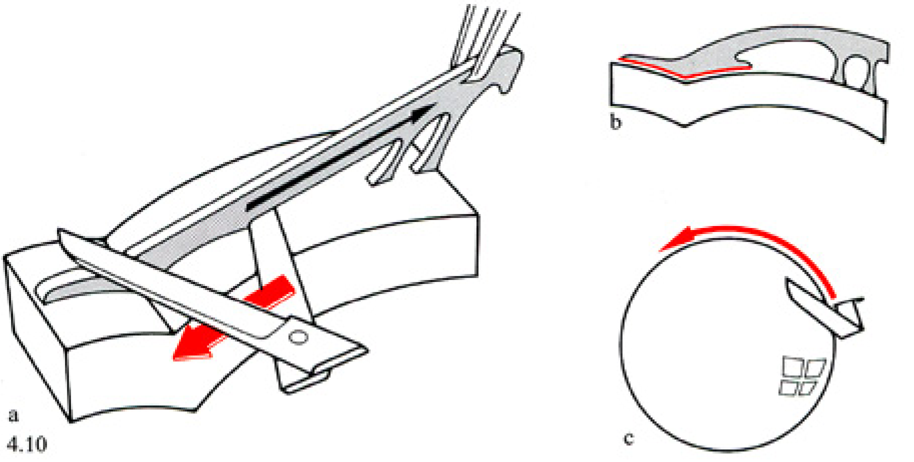

Fig. 4.10. **Prevention of lateral shifting in the dissection of a fornix-based conjunctival flap**

a The conjunctiva is pulled away from the limbus by strong forceps traction, while the scissor blade is pushed in the opposite direction when the cut is made. This exploits the retractile tendency described in Fig. 2.64.

b The combination of traction and countertraction allows division of the conjunctiva flush with its limbal attachment.

c With lateral shifting neutralized, the cut follows the intended path along the limbus

space with fluid; this will also inhibit shifting of the perilimbal fibers when the incision is made.

The easiest method of dissecting the perilimbal zone is to open the episcleral space with a *small radial incision*, insert one blade of a scissors into the space through the incision, and then continue the cut on a path parallel to the limbus. The shifting tendency of the tissue will tend to deflect the cut toward the mobile zone (see Fig. 4.9), but this can be prevented by exerting firm traction on the conjunctiva, pulling it away from its fixation site at the limbus (Fig. 4.10).

Once the episcleral space has been entered, the sclera can be satisfactorily exposed by *blunt dissection*. The surgeon should keep the scissors blades continuously in *contact with the sclera* and pressed firmly against its surface (Fig. 4.11), especially if visibility is poor and he must rely on tactile feedback. This ensures that the dissection will indeed follow the scleral surface while sparing other structures inside the orbit.[1]

A **limbus-based flap** is developed by opening the conjunctiva over the episcleral space and dissecting from

[1] This is particularly important in dissections behind the ocular equator (e.g., for enucleations or procedures at the insertion of the musculus obliquus inferior). Unless the scissors blades stay in contact with the sclera, they will stray into the orbit, and separation of the blades can inflict damage within the close confines of the orbital cone.

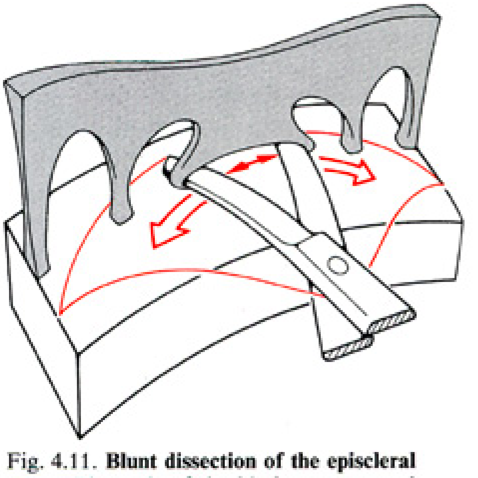

Fig. 4.11. **Blunt dissection of the episcleral tissue**. The ends of the blades are pressed firmly against the sclera. They contact the fibers to be dissected near their point of attachment, where they are most sectile. The guidance path of the blades follows the ocular surface to preserve the adnexa and orbital tissues

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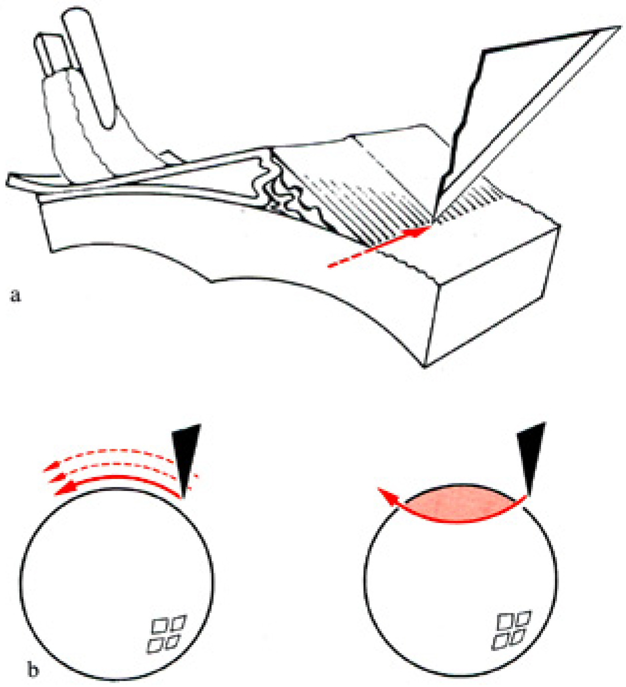
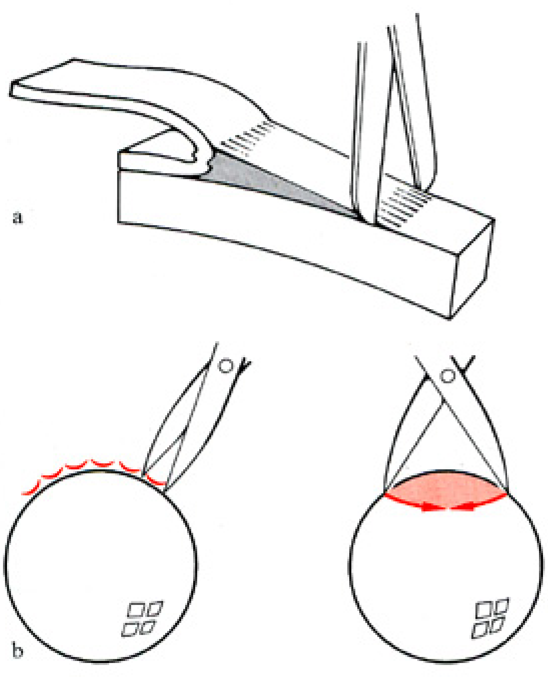


4.12

Fig. 4.12. **Dissection of a limbus-based flap in the fibrous perilimbal zone with a pointed blade**

a Shifting tendencies are minimized by making the perilimbal subepithelial fibers tense. Pressing the reflected flap down onto the cornea creates selective sectility, i.e., only the row of fibers directly in front of the blade is made tense. The adjacent fibers and the epithelial lamella attached to them are in a lax condition and so are less vulnerable (see also Fig. 2.55c).

b Avoidance of hazardous vectors during blade guidance. *Left:* Each cut is made parallel to the limbus to avoid vector components directed toward the cornea. *Right:* There is a tendency to curve the incision in the opposite direction when the surgeon is resting his hand comfortably on a support (i.e., movements tend to occur as a rotation about the support). In this case there are vector components directed toward the cornea, and there is a risk of inadvertent perforation of the conjunctival flap at its base



4.13

Fig. 4.13. **Scissor dissection of a limbus-based flap in the perilimbal zone**

a When the flap is reflected the taut subepithelial fibers closely overlie the sclera, so the scissor points can divide them only when the blades are held vertically (see Fig. 2.85).

b Avoidance of hazardous vectors. *Left:* On closure from a small blade aperture, the tips of the scissors are guided almost parallel to the limbus. *Right:* On closure from a large aperture, the tips move in the direction of the reflected conjunctival flap and may perforate it

there toward the limbus. The incision starts in the easily dissected potential space and terminates at the fixation zone. At that site manipulations must be performed with greater precision, especially if the perilimbal zone is to be mobilized as far as the corneal epithelium. Tissue sectility in that area is high, and the layer to be dissected is thin and fragile, so there is a correspondingly greater risk of inadvertent flap perforation. This is avoided by guiding the blades strictly *parallel to the limbus*, as this eliminates vector components directed toward the cornea (Figs. 4.12, 4.13). Even so, there is a danger of perforation if the *lateral shifting tendency* of the tissue draws the conjunctival flap into the path

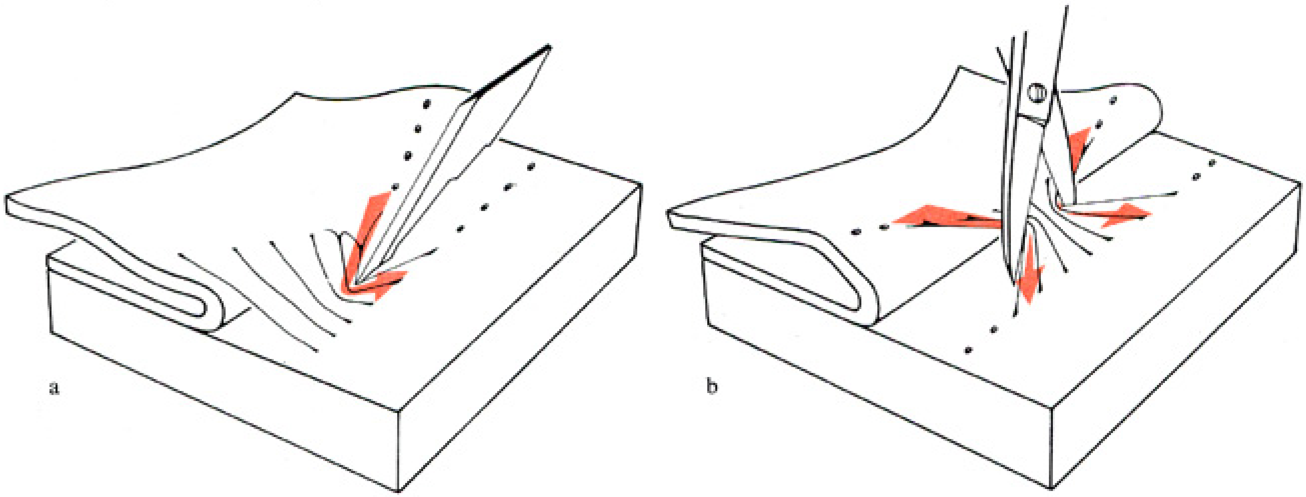


Fig. 4.14. **Effect of lateral shifting tendency during dissection at the limbus**. A blade directed parallel to the limbus pushes fibers from the reflected flap toward their scleral attachment. The greater the distance traveled by the blade, the more tissue is shifted scleralward. Ultimately the conjunctival surface may enter the cutting path and become sectioned.

a Lateral shifting tendency when cutting with a razor blade tip.

b Shifting tendency when cutting with scissors. Tissue is drawn between the blades during closure. Since the amount of shift (and the danger of flap perforation) depends on the distance traveled by the cutting point, it varies with the blade aperture and can be reduced by taking small scissor bites (see also Fig. 4.13b)

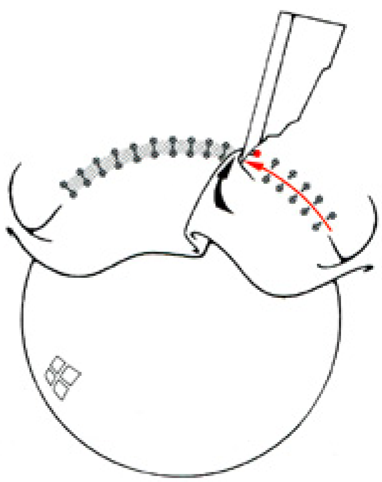


Fig. 4.15. **Signs of impending perforation during lateral shifting of the conjunctival flap**. Tissue folds crossing the limbus are a sign that there are still undivided fibers in front of the blade. These fibers pull the conjunctival flap toward its site of scleral attachment and may draw the epithelial lamella into the path of the blade. *Note*: The presence of these folds indicates that the countertension on the flap is insufficient to neutralize the shifting tendency. The remedy is increased countertraction on the flap (as illustrated in Fig. 4.12a).

In the drawing the *white* portion of the perilimbal zone (to the *right* of the fold) represents the part already divided; the *gray* portion (*left*) is not yet divided

of the blade (Figs. 4.14, 4.15). This is avoided by applying *countertraction* on the flap in the direction of the cornea.

When all the subepithelial fibers have been divided as far as the limbus, the fold at the reflected epithelial layer appears as a *sharp step*, signifying that the episcleral dissection is complete and any further cuts would perforate the flap itself (Fig. 4.16).

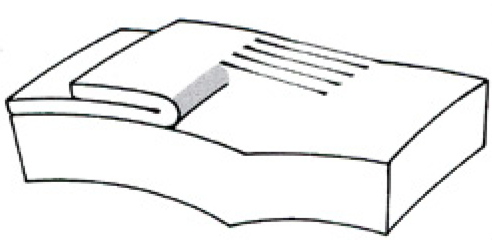


Fig. 4.16. **The completion of deep episcleral dissection.** When the last subepithelial fiber attachments have been severed, a conspicuous step (*gray*) appears at the reflection of the epithelial lamella. Where fibers are still present, the flap surface appears to be continuous with the sclera

4.3 Subepithelial Dissection ("Superficial Dissection")

Superficial dissection separates the conjunctival epithelium from the resilient subepithelial fibrous layer. It is technically more demanding than episcleral dissection, because it does not follow a preexisting space. The surgeon himself must *define the plane of the dissection*.

The *size and mobility* of superficial conjunctival flaps depend on how carefully the contractile subepithelial fibers have been divided, i.e., how thinly the flap has been developed.[2] This is made difficult by the poor sectility of the subepithelial fibers. The fibers may shift upward or downward ahead of the blade, depending on the predominance of the fixation sites, resulting in a corresponding deviation of the cut. The surgeon's task is to apply measures that will *increase the sectility* of the subepithelial fibers while influencing the *shifting tendencies* in a way that will allow the

[2] The subepithelial dissection of a sliding flap for whole-cornea coverage is especially challenging. A very thin flap is needed not just to obtain a tension-free flap of adequate size but also for cosmetic reasons, since the flap should be as transparent as possible.

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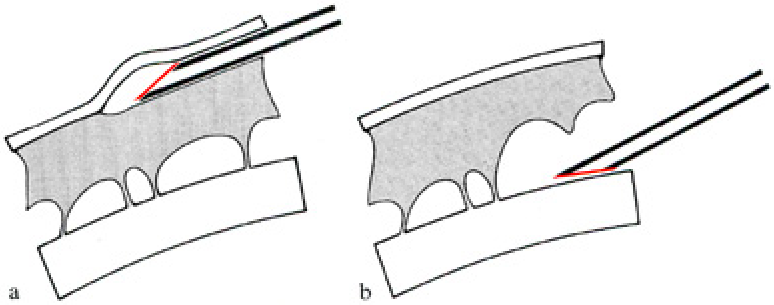
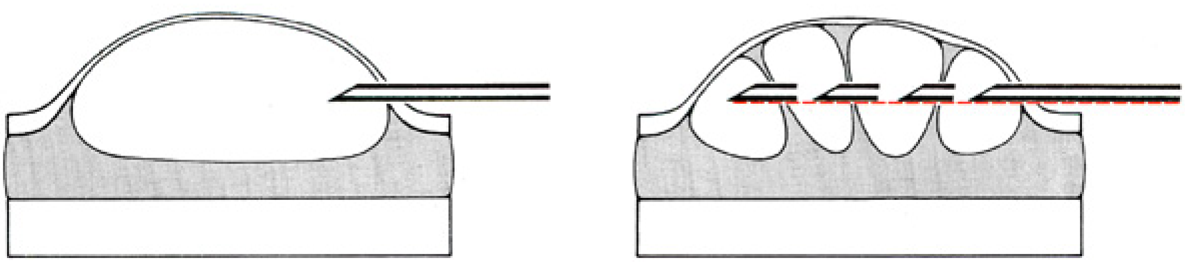


4.17 a b

Fig. 4.17. **Fluid infiltration of the conjunctiva**

a Superficial infiltration of the subepithelial fibers. The cannula is inserted just below the conjunctival surface, its blunt side facing upward to avoid epithelial injury. Superficial infiltration increases the tension of the subepithelial fibers.

b Deep infiltration of the episcleral space. The cannula glides smoothly over the sclera with its blunt side turned downward. Infiltration of the episcleral space reduces tension on the subepithelial fibers



4.18 a b

Fig. 4.18. **Technique of subepithelial infiltration**

a Dissection with fluid: Injecting fluid from a stationary cannula forms a large vesicle which disrupts the finer subepithelial fibers and creates a cavity. When incised, the whole vesicle collapses and cannot maintain tension during the dissection.

b Increasing tension with fluid: If the cannula is advanced during the injection, numerous small fluid chambers are formed which provide tension even during progressive superficial dissection

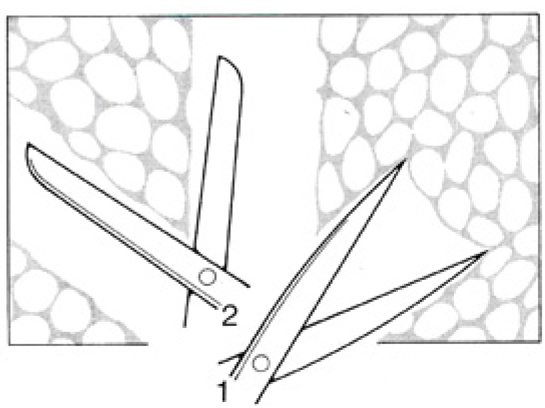
dissection to proceed on the desired plane.

General sectility can be increased by *infiltrating the tissue with fluid* (Figs. 4.17a, 4.18), and employing a special dissection technique to avoid premature drainage of this fluid (Fig. 4.19).

Local sectility can be enhanced by making the fibers tense with forceps or with the *scissors* itself (Fig. 4.20). This tension can be produced only if the fibers are *firmly anchored to the sclera*. If this fixation is absent, the fibers will shift toward the epithelium, and a thin flap cannot be dissected. Even exerting greater upward traction will not offset this tendency and would only draw more fibers toward the epithelium, resulting in an even thicker flap (Fig. 4.21).

The surgeon's main task in superficial dissection, then, is to *preserve* existing *deep attachments* and to *create* them where they do not already exist. Above all, he must avoid opening the episcleral space either by cutting (Fig. 4.21 *left*) or by fluid infiltration (Fig. 4.17b). In the region close to the *fornix*, where the conjunctiva lacks a deep anatomic fixation, this fixation must be created artificially by *traction to the subepithelial fibers* (e.g., with traction sutures, Fig. 4.22). This traction simultaneously *redirects* the

Fig. 4.19. **Dissection of the infiltrated conjunctiva.** Tension is maintained in the infiltrated region as long as possible by first cutting discrete channels through the infiltrated tissue (*1*), leaving "pillars" in between to preserve tension. These pillars are then divided in a second step (*2*)



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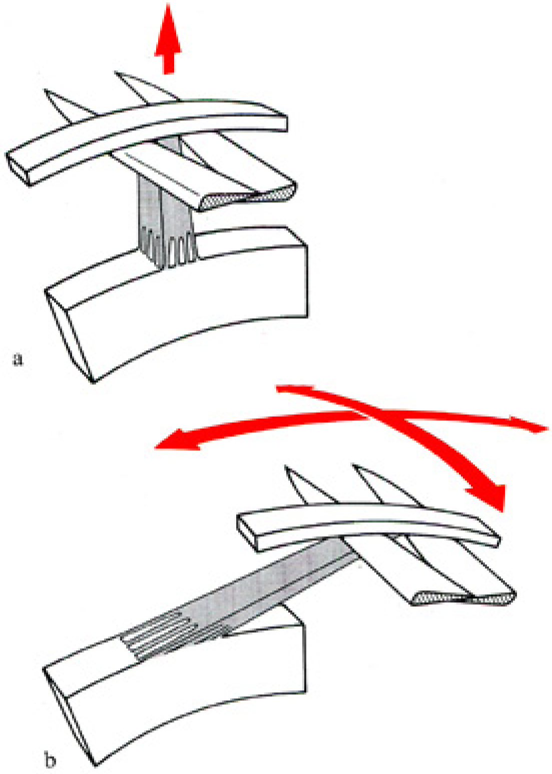

Fig. 4.20. **Stretching the subepithelial fibers with scissors**

a Stretching the fibers by lifting the fibers vertically from the globe.

b If the tension produced by this maneuver is insufficient, it can be increased by adding a lateral motion of the scissors

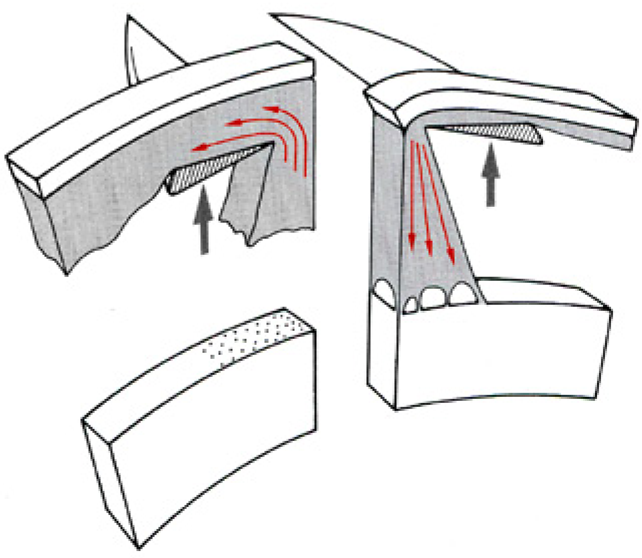

Fig. 4.21. **Lateral shifting tendency as an aid to conjunctival dissection.** When stretched, the fibers ahead of the advancing blade are shifted in the direction of the strongest fixation. *Right*: Fibers securely attached to the sclera are shifted toward that attachment. Exerting more tension accentuates this effect, yielding a thinner superficial layer. *Left*: In the absence of scleral attachments, the epithelial lamella becomes the strongest fixation site, and the subepithelial fibers are shifted toward it by the advancing blade. This results in a thick dissected layer, which becomes even thicker as more upward tension is applied

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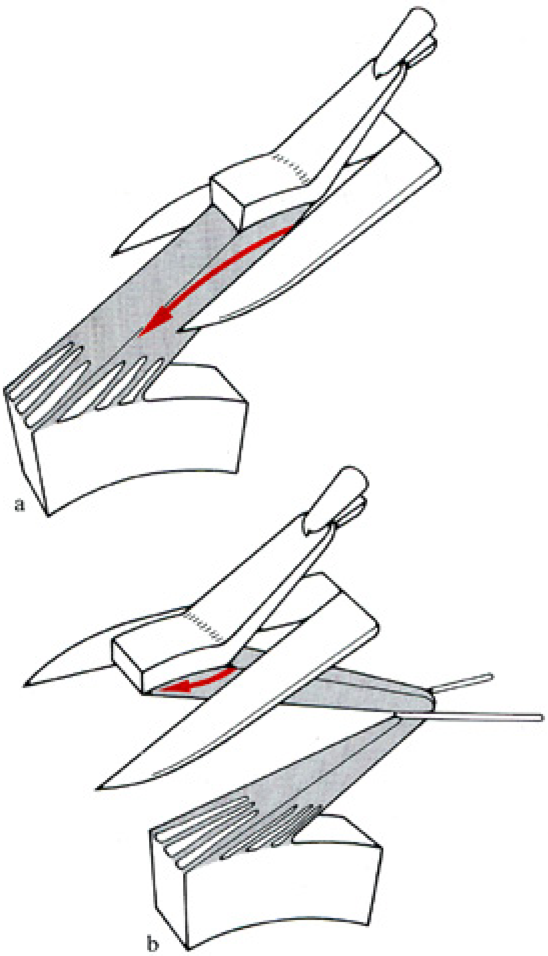


a

b

Fig. 4.22. **Inverting the angle of attack of the cutting point**. The subepithelial fibers cause a lamellar deflection of the cutting point when under tension. The angle of attack determines the direction of the deflection.

a If the subepithelial fibers *above* the scissors are pulled toward the scissor joint by traction on the epithelial lamella, they present to the cutting point in a manner that deflects the cut downward (toward the sclera), and the dissected superficial layer contains more subepithelial fibers.

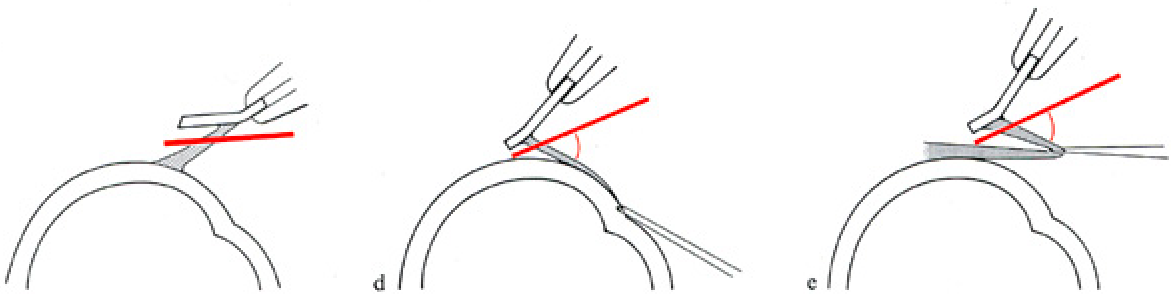
b If the subepithelial fibers *below* the scissors are pulled toward the scissors joint, the angle of attack is inverted, the cutting point is driven upward, and a thinner lamella is obtained.

c–e Angle of attack of the scissors on the subepithelial fibers. The *red line* indicates the path of the cutting point.

c Traction on the *superficial lamella* presents the subepithelial fibers in a way that deflects the cut downward (analogous to **a**).

d Inverting the attack angle: At sites where the subepithelial fibers are well anchored to the sclera, a traction suture *in the globe* can present the fibers at an angle that deflects the cut toward the surface.

e Inverting the attack angle: At sites where the subepithelial fibers lack adequate deep fixation, the angle is inverted by a traction suture placed *through the fibers themselves* (analogous to **b**)



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subepithelial fibers, producing a lamellar deflection which drives the cutting point of the scissors toward the epithelium and helps to keep the dissection on a superficial plane.

The deep fixation can produce an **infolding effect** when the flap is *elevated*. These infolds, which can lead to inadvertent perforation of the thin flap (Fig. 4.23), are avoided by applying a *skillful blend of tension and countertension* and by continually adjusting to the changing conditions. Perforations can also be avoided by cutting with a *small scissors aperture* so that the folds are not drawn into the interblade area.

Superficial and deep flap dissection employ different techniques of *scissor guidance* in that a large blade aperture is generally used for deep dissection and a small aperture for superficial dissection. Also, whereas blunt scissors may be used for deep dissection, superficial dissection requires sharp scissors with pointed tips that can cut effectively in small "bites" (see Fig. 2.84a).

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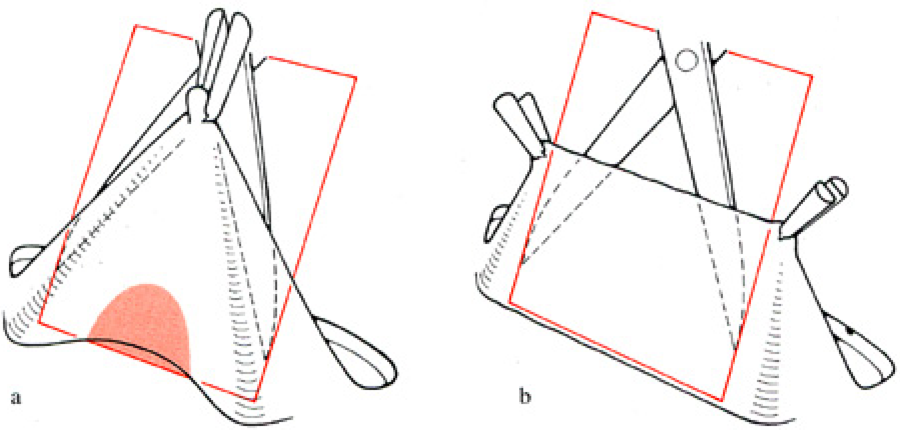

Fig. 4.23. **Deformation of the conjunctiva by local traction to the subepithelial fibers**

a On elevation of the conjunctiva, the still-adherent subepithelial fibers produce a deep infold that may come between the scissor blades leading to perforation of the epithelial lamella. This is avoided by taking very small scissor bites, i.e., working with a small interblade area.

b If the conjunctiva is stretched out flat so that it parallels the guidance path of the scissors, the scissors can cut close along the surface without perforating it. The guidance path of the scissors (i.e., the surface on which the cutting edges move during closure) is outlined in *red*

Fig. 4.24. **Fixation of a conjunctival flap by plicating the lateral wound margins**. The lateral wound margins are plicated with sutures and fixed episclerally. This exerts tension on the flap and presses it onto the cornea. The tension achieved depends on the number of contractile subepithelial fibers still adherent. But this also increases the retractile tendency of the flap, causing it gradually to recede

Fig. 4.25. **Fixation of a conjunctival flap by lateral wedge excisions**. Redundant conjunctiva at the lateral wound edges is excised, and the margins are approximated with sutures. This eliminates the bulging effect in the preceding figure and promotes rapid adhesion

4.4 Suturing the Conjunctiva

The **margins** of conjunctival wounds have a tendency to curl due to the resiliency of the subepithelial fibers. To obtain proper apposition of the layers for suturing, this *retraction* must be offset by *countertraction* on the subepithelial fibers. The fibers are engaged with the tooth of one forceps tip or grasped directly with a small forceps and stretched out. This expands the overlying epithelial layer, which can then be pierced at its margin (recognized by its distinctive vascular pattern) with a suture needle.

The inherent compliance of the conjunctiva allows great latitude in the selection of suturing techniques. Tissue deformations by the suture rarely compromise the operative goal. They can even be utilized to effect the compression necessary for uniting the tissues.

The postoperative adherence of the conjunctiva is extremely good and rapid on a vascular substrate but is poor on the avascular corneal surface. Hence, **conjunctival flaps** for covering the cornea should be fixed to the vascularized circumcorneal tissue. Flaps for *partial corneal coverage* can be advanced onto the cornea and made tense by shortening the wound margins with sutures (Figs. 4.24, 4.25), but this tension cannot withstand strong disruptive forces. To counteract high pressures, epicorneal sutures are used to secure the flap (Figs. 4.26, 4.27).

Fig. 4.26. **Fixation of a conjunctival flap over a small lamellar keratectomy**. The conjunctival flap is tacked to the cornea with a watertight lock-stitch suture. The curvature of the wound line controls the position of the linking thread segments, so that they overlie the conjunctival side of the suture (see Fig. 2.117)

Fig. 4.27. **Fixation of a flap over a large lamellar keratectomy parallel to the limbus.** The flap is secured with an inverted meandering suture, whose bridging segments keep the flap pressed firmly onto the cornea. (With a lock-stitch suture, the bridging segments would slip off the flap because the curvature is opposite to that in Fig. 4.26)

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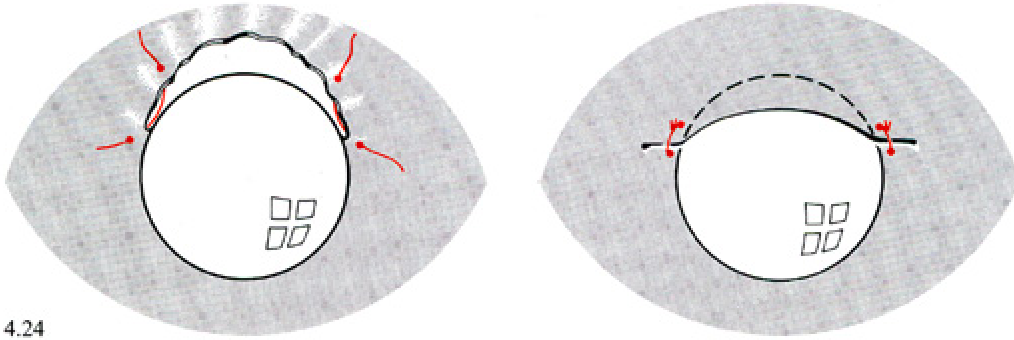

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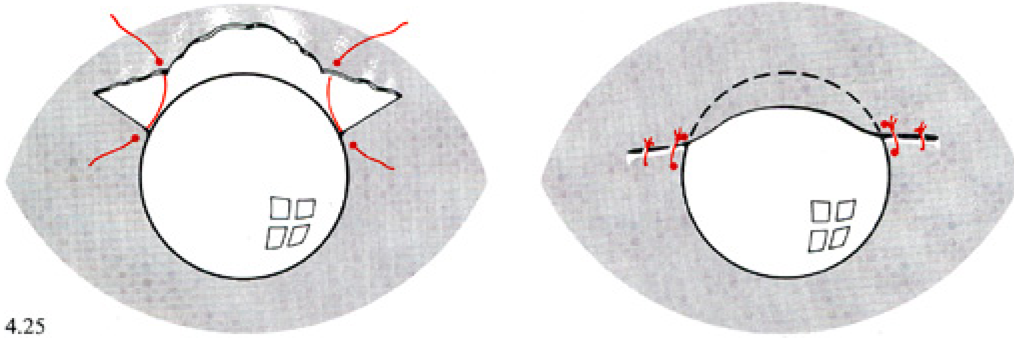

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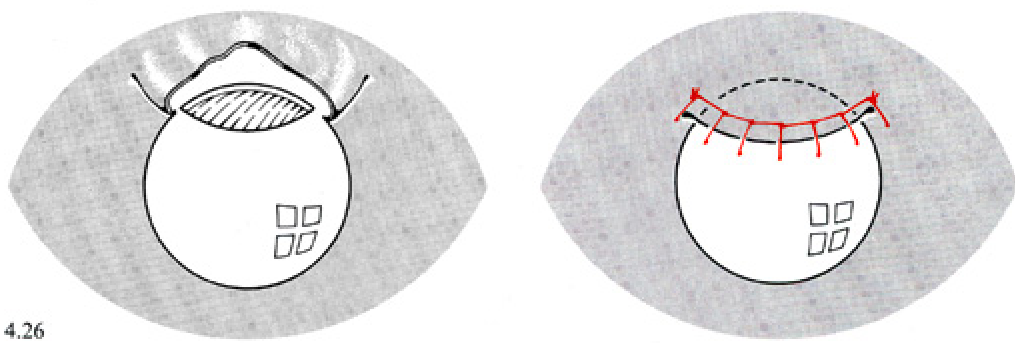

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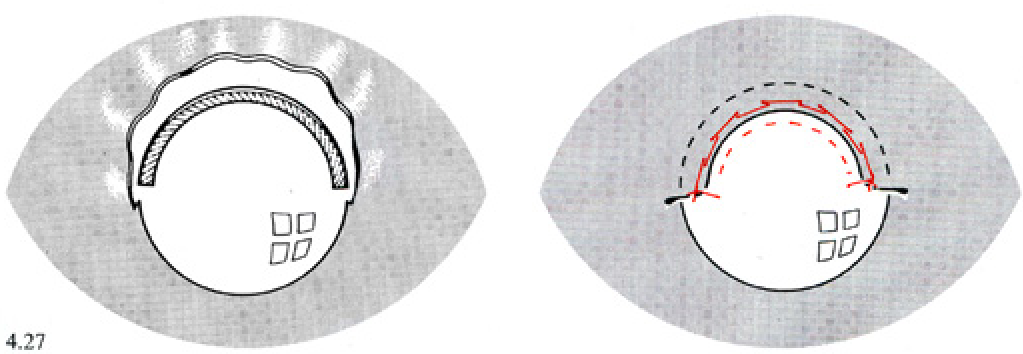

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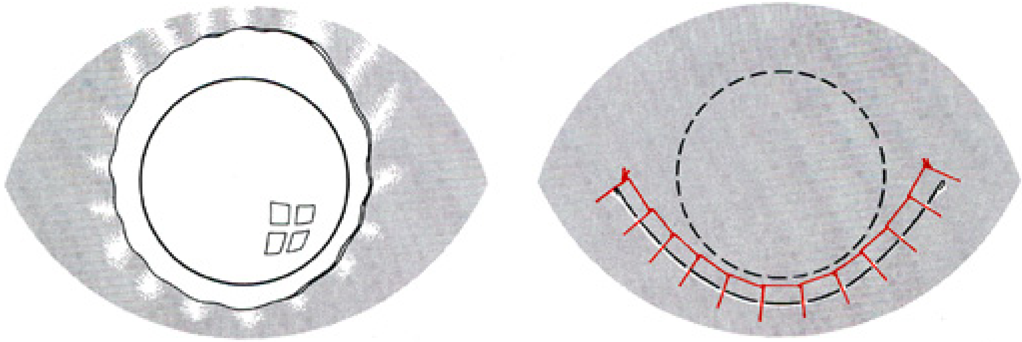

Fig. 4.28. **Fixation of a conjunctival flap covering the whole-cornea.** The thin, delicate flap is tacked to the sclera with a lock stitch. The curve of the suture line keeps the linking segments in the correct position for compressing the flap onto the limbus (cf. Fig. 4.26)

Flaps for total corneal coverage are advanced over the cornea and sutured to the vascularized limbal sclera on the opposite side. Flaps of this size are very thin and can tolerate little tension at the wound margin, so suture types are chosen that exert pressure over a large area (Fig. 4.28).

In **electrocoaptation** the conjunctiva is squeezed into a fold between the blades of a *bipolar forceps* (Fig. 4.29) and then coagulated. The coagulum forming between the electrodes is comparable to a fast-setting adhesive. Though unable to resist strong forces, electrocoaptation is appropriate for the fixation of conjunctival flaps that are placed without tension and adhere rapidly to the substrate.

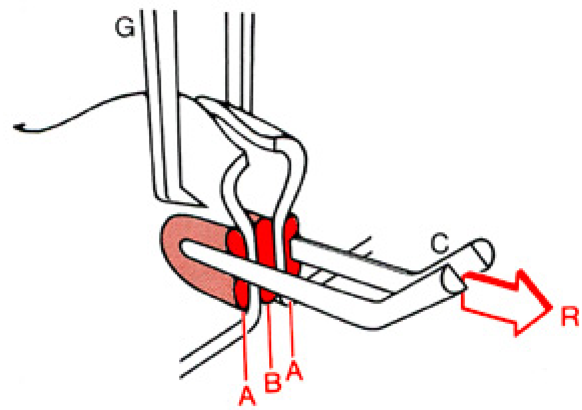

Fig. 4.29. **Electrocoaptation of the conjunctiva.** *G* Grasping forceps for approximating the conjunctiva. *C*, Bipolar diathermy coapting forceps. The diathermy effect bonds the conjunctival fold (see Fig. 4.24) together by coagulated protein (*B*). But similar coagula can form between the conjunctival surface and coagulating forceps (*A*). If the adhesions at *A* are stronger than the adhesion at *B*, the latter (which is the goal of the manipulation) may separate when the coapting forceps are opened. This is avoided by keeping the coapting forceps closed while withdrawing it along the fold (*arrow R*). Additionally, the grasping forceps *G* holding the conjunctival fold together is removed only after the coapting forceps *C* has released the tissue

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