

Surface phenomena captured in KCS indicate diseased surface cells, epithelial oedema, mucus adherence, and disruptions of surface integrity. Of these, some or all may be present at the same time. The changes are usually most pronounced in the interpalpebral area but the whole surface may be involved.

Before staining are visible greyish surface cells, either spread over the surface or in rows and groups; cystic spaces; strongly light-reflecting mucus adhering to the surface; and filaments.

Fluorescein sodium shows a *dual staining property*, a non-fluorescent and a fluorescent one. The *punctate non-fluorescent* staining (yellow-brown) reveals diseased surface cells. The *fluorescent* (green) one reveals penetration of fluid into: (1) *circumscribed spaces* – the resulting *punctate fluorescent staining* visualises diseased surface cells (probably by penetration below them) and cystic spaces; and (2) the *tissues* – the resulting *flecks* indicate surface disruptions. *Rose bengal* stains diseased surface cells red.

Hence, with the two dyes, *diseased surface cells* are visualised in three modes: as *yellow-brown dots* (with non-fluorescent fluorescein), as *green dots* (with fluorescent fluorescein) and as *red dots* (with rose bengal). Basically, all reveal the same cells but with the green dots it might be difficult to distinguish surface cells from other cystic spaces (such as those due to epithelial oedema) visualised at the same time. With non-fluorescent fluorescein, the cells show various staining densities but no further details (an exception are brighter dots surrounded by a narrow brownish

rim, captured only in two patients in connection with impaired corneal sensitivity). Also rose bengal shows various staining densities; additionally, the dye visualizes some cell details such as deeply stained dots interpreted as cell nuclei; also cell borders and cell fragments are easier to discern with rose bengal. The stained cells, whether with non-fluorescent fluorescein or rose bengal, may be present individually or in rows and groups, and the staining may be confluent. They measure about 30 µm in diameter, often less (about 15–20 µm, exceptionally more (about 45 µm)). The non-fluorescent staining is relatively short-lived and usually transforms into the fluorescent one; this phenomenon is difficult or impossible to observe against a green background caused by fluorescein diffusion. Rose bengal staining persists much longer, and occasionally some cells become displaced or disappear after the application of the dye.

Epithelial oedema manifests as cystic spaces of which many stain brilliantly green with fluorescein.

Mucus adhering to the surface appears as more or less strongly light-reflecting dots, lumps, and patches; smaller or larger sheets, some showing holes, rolled-up edges, and emanating strands; and thinner or thicker threads, often intertwined. With fluorescein, it appears yellow. With rose bengal, strongly light-reflecting mucus shows a brightly red or pinkish hue in focal illumination; its dark appearance in retroillumination indicates a light-obstructing property. Occasionally, some strands seem not to stain (see also Part II).

Disruptions of surface integrity are visualised with fluorescein as *green flecks*. With the slit lamp, their development after the application of fluorescein can often be predicted by the presence of patches of greyish surface cells but they appear also in inconspicuous areas. There may be only a few, developing slowly, or many, developing rapidly. Flecks situated close to each other may rapidly float together with large green areas with diffuse, often undulating borders as a result. The flecks show surface cells staining with non-fluorescent fluorescein and rose bengal. Larger flecks may show many small cells with prominent nuclei and often also patches of surface-adherent mucus; small flecks sometimes show small filaments attached to them.

The flecks show also *rounded bodies*, measuring about 9–12 μm , and similar bodies are often present also outside them. Only rarely such rounded bodies were captured concentrated in small areas reminiscent of infiltrates occurring in the acute stage of adenovirus epithelial keratitis or Thygeson's superficial punctate keratitis but lacking the strong light-reflecting property. Their nature is unclear as with the present method cells with altered membranes, incipient cell swelling, invading inflammatory cells (and in KCS perhaps also epithelial oedema with small intercellular cystic spaces, cell and mucus fragments) would

appear similar. For these reasons, I have chosen to term them 'rounded bodies' throughout (see also 'Final Remark').

The application of fluorescein is painless, and the dye has no known *adverse effects* on the corneal epithelium. Rose bengal has a stinging property, and after its application in eyes preinstalled with fluorescein appear myriads of green dots in corneae previously appearing normal or showing only a few green dots. This striking effect is probably caused by disruption of intercellular junctions allowing the green fluid to penetrate below the cells. (There is one more phenomenon occurring after the application of rose bengal – an appearance of rounded bodies the nature of which is unclear.)

Included in this chapter are also some sources of possible diagnostic errors: surface staining appearing in areas of *damage unrelated to KCS* (such as in trichiasis) or in *iatrogenic* damage caused by the paper strip used in the Schirmer test; green flecks showing similarity to those occurring in *herpes simplex* (but morphology observed before the application of the dye usually prevents confusion); and larger 'mucus plaques' in *herpes zoster ophthalmicus* epithelial keratitis (which differ from adhering mucus in KCS in that they do not show threads or strands).

Before Staining (1)

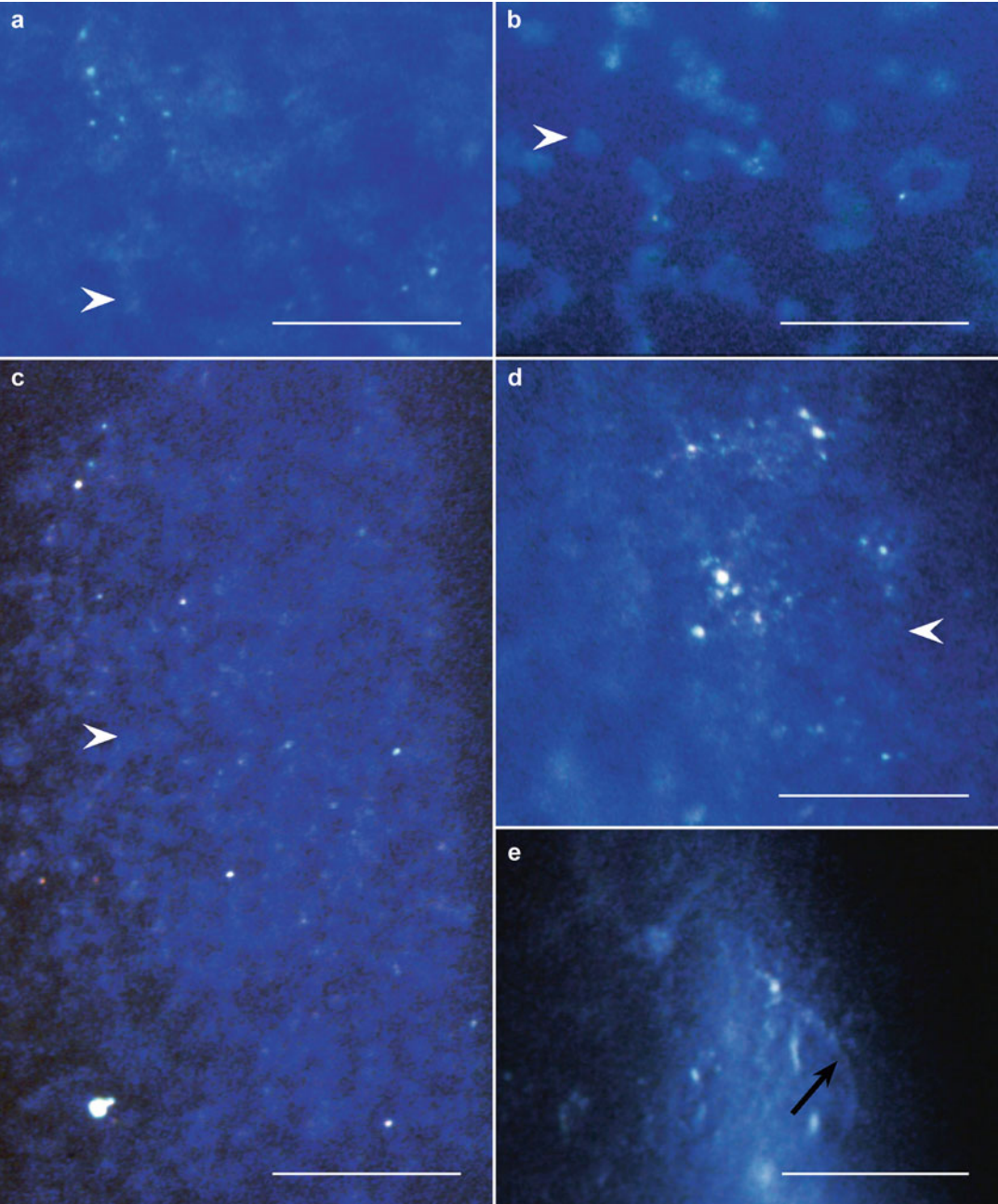


Fig. 2.1 (a–d) The epithelium shows many greyish surface cells (*arrowheads*), individual, in groups and rows, or confluent. In (e) is visible a mucus strand pos-

sibly adhering to the surface (*arrow*). The origin of the light-reflecting bright dots visible in all photographs is uncertain (cf. Fig. 4.20)

Before Staining (2)

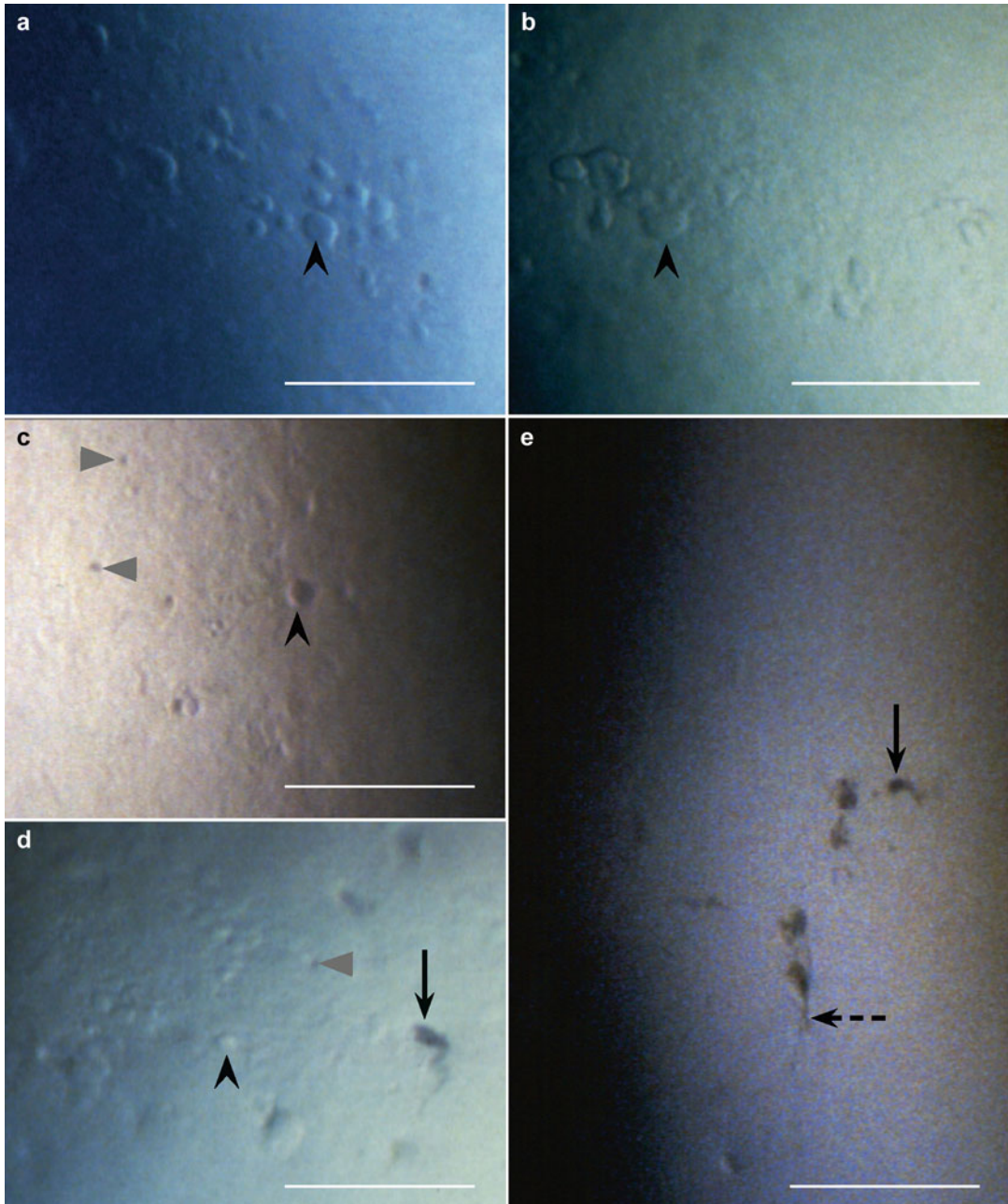


Fig. 2.2 (a–d) Larger and smaller epithelial cystic spaces (*black arrowheads*) and rounded bodies (*c, d, grey arrowheads*). In (*d, e*) are visible larger pieces of

mucus (*plain arrows*); the *dashed arrow* in (*e*) indicates attachment point of a small filament (cf. Part II)

Punctate Non-fluorescent and Fluorescent Fluorescein Staining

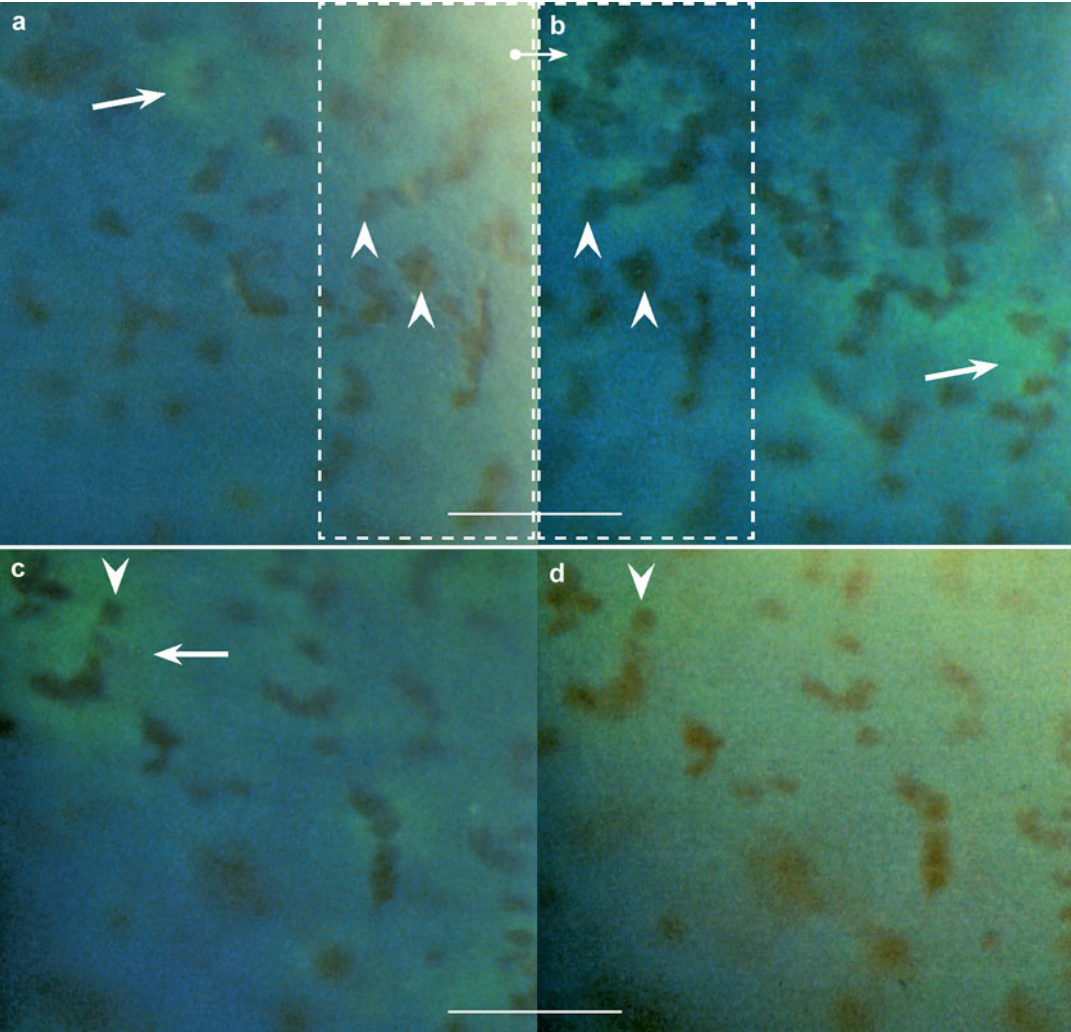
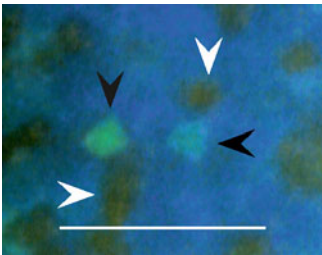


Fig. 2.3 Non-fluorescent fluorescein staining of diseased surface cells (*arrowheads*), individual, in groups and rows. Depending on illumination, the hue varies between brownish and yellowish (cf. **a**, **b**, the area in *frame*, and **c**, **d**; the

arrowheads are placed in corresponding locations). The *arrows* in (**a–c**) indicate incipient fluorescein diffusion into the tissues (green)

Fig. 2.4 The brownish hue of non-fluorescent staining of diseased surface cells (*white arrowheads*) contrasts with the green fluorescent one (*black arrowheads*) indicating cystic spaces



Dynamics of Punctate Fluorescein Staining (1)

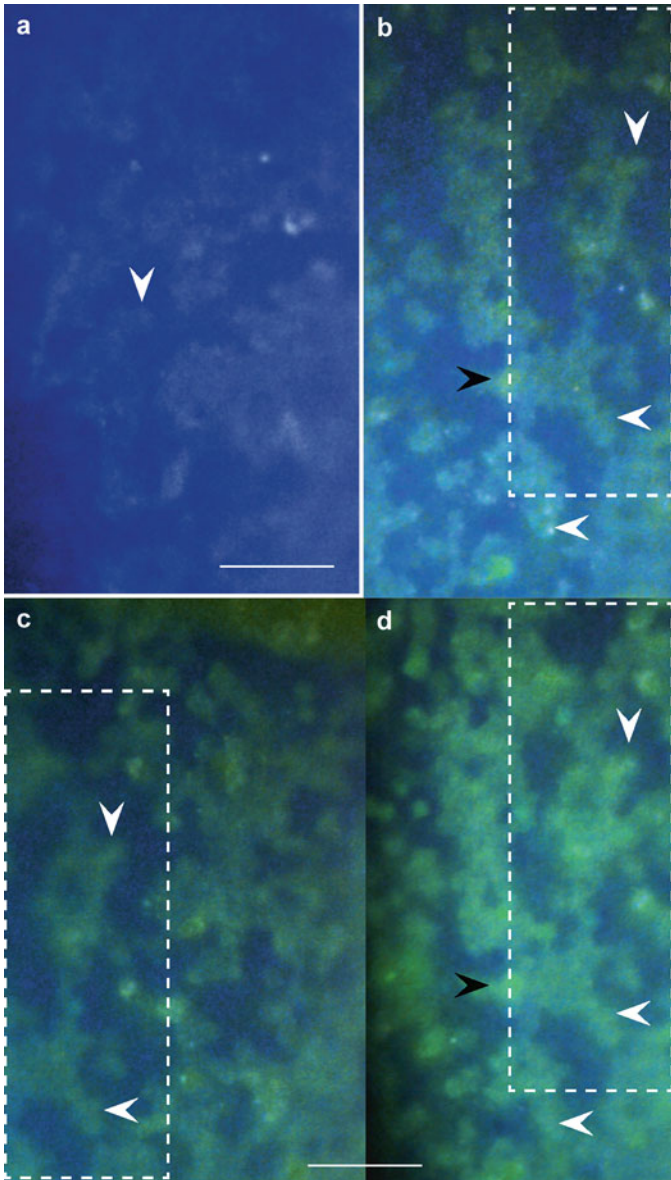


Fig. 2.5 (a) Greyish surface cells (arrowhead) visible before staining. (b) A different area of the same cornea. After the application of fluorescein is visible a mixture of fading non-fluorescent (yellow-brown) and incipient fluorescent (green) staining of surface cells (white arrowheads). Some of the more brilliantly green dots (black arrowheads) probably represent small cystic spaces (cf. Fig. 2.7). (c–d) The intensity of the green fluorescence increases with time; in this series, the staining seems limited to surface cells (white arrowheads) and cystic spaces (black arrowheads); so far, there is no diffusion into the stroma (cf. also Figs. 4.28, 4.29 and 4.31). (The frames in b–d indicate the same area; the arrowheads are placed in corresponding locations)

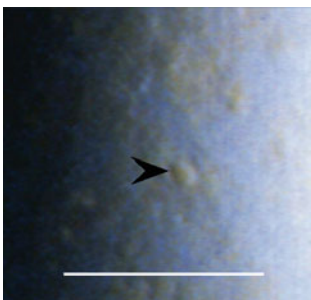


Fig. 2.6 A small cystic space (arrowhead) captured in the cornea shown in Fig. 2.5. The green fluorescence was not elicited in this illumination

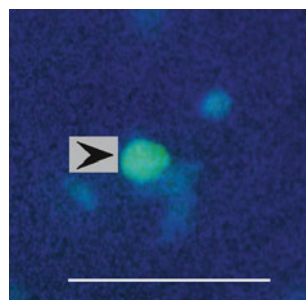


Fig. 2.7 A rounded cystic space (arrowhead) staining brilliantly green with fluorescein

Punctate Fluorescent Staining: Surface Cells Versus Cystic Spaces

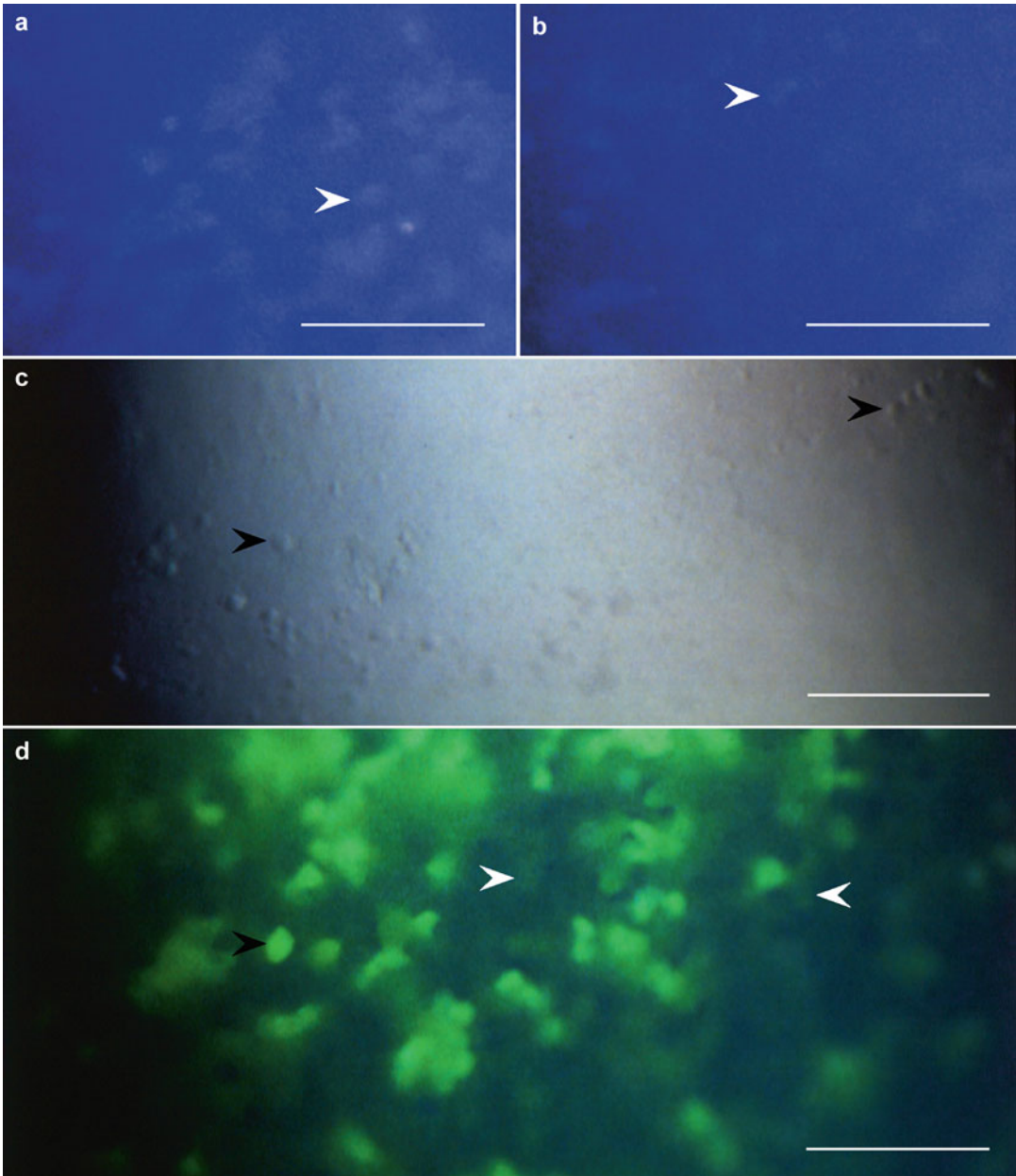


Fig. 2.8 This cornea shows (a, b) greyish surface cells (arrowheads) and (c) many cystic spaces (arrowheads). (d) After the application of fluorescein appeared many green dots; the hue varies between a brilliantly green visualising cystic spaces (black arrowhead) and darker one visualising surface cells (white arrowheads)

Dynamics of Punctate Fluorescein Staining (2)

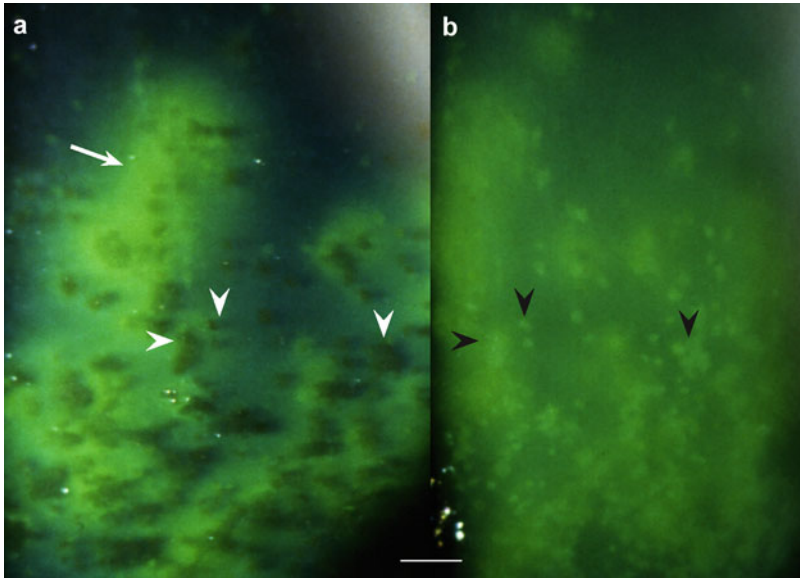


Fig. 2.9 (a) Non-fluorescent fluorescein staining of surface cells, individual or grouped (*arrowheads*) visible against green background caused by fluorescein diffusion into the tissues (*arrow*). (b) After a few minutes, the whole area appears as a green fleck; the

non-fluorescent staining has transformed into a fluorescent one (green dots, *arrowheads*). (The arrowheads are placed in locations implying patterns similar to (a) but their correspondence is uncertain)

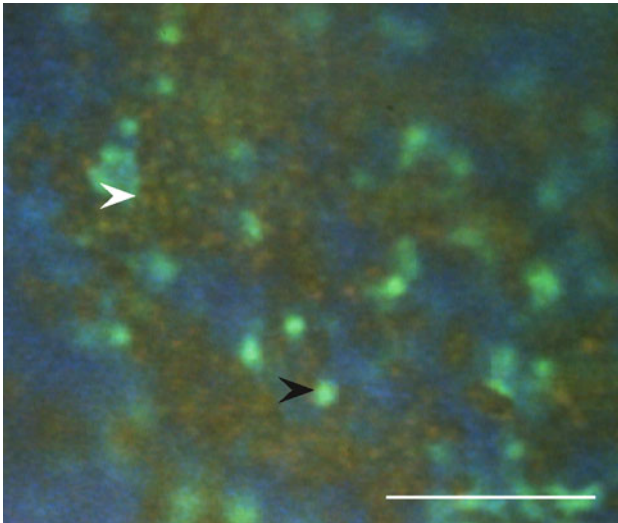


Fig. 2.10 A heavy and partly confluent non-fluorescent fluorescein staining showing many brighter dots (*white arrowhead*) surrounded by a thin darker rim. The circumscribed brightly green staining indicates cystic spaces (*black arrowhead*)

Comment

An interpretation of this phenomenon captured only in two patients with impaired corneal sensitivity (cf. Figs. 4.32, 4.33, 5.2, 5.4 and 5.5) is left open.

Fluorescent (Green) Flecks in White Light

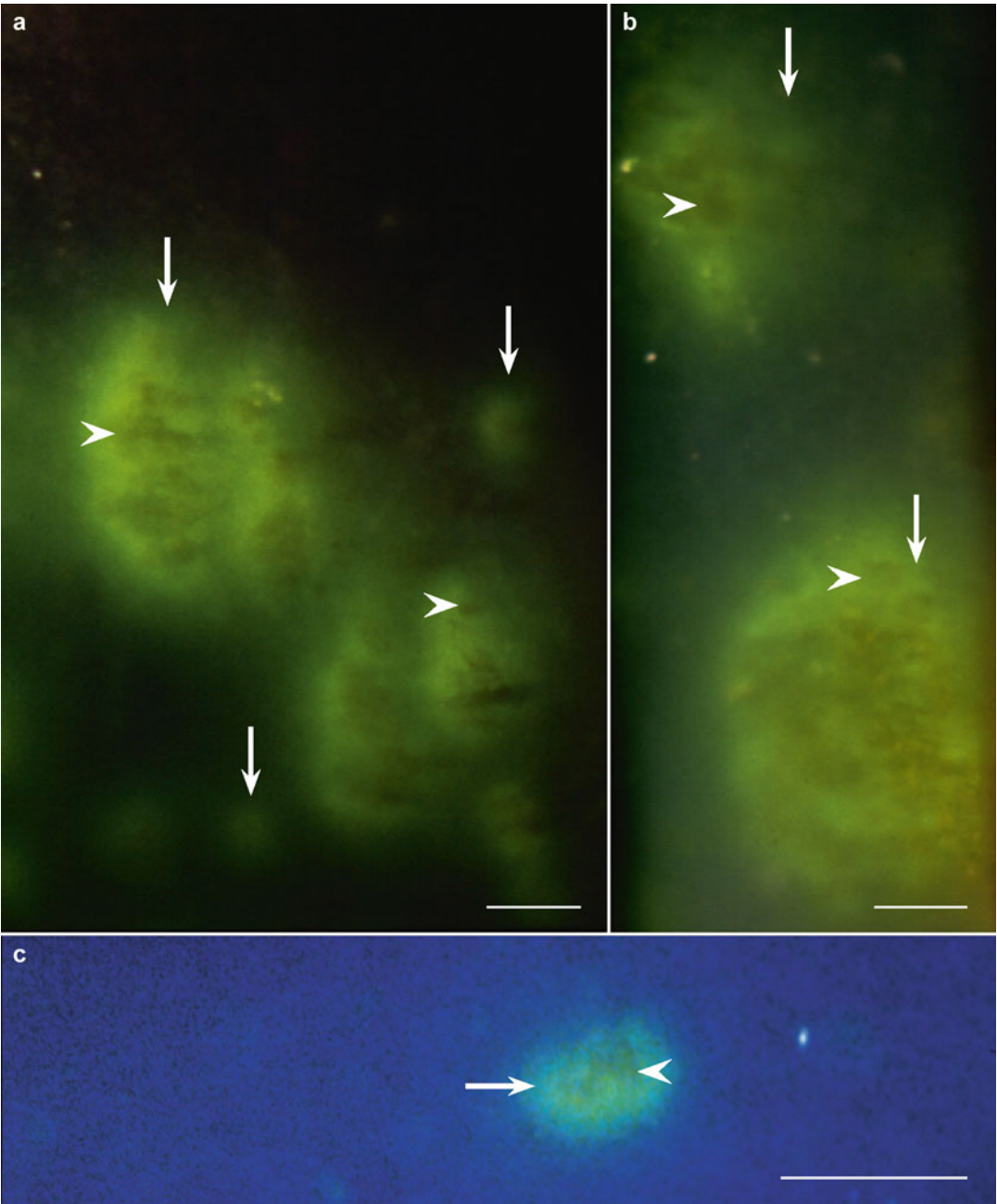


Fig. 2.11 (a–c) Fluorescent (green) flecks (*arrows*) are the result of diffusion of the dye into the tissues. Surface cells stained with non-fluorescent fluorescein (*arrow-*

heads) appear yellow-brown. In (a) is visible a confluence of several small flecks, (b) shows two larger flecks (*arrows*) and (c) a small solitary one

Fluorescent Flecks and Colour Filters (1)

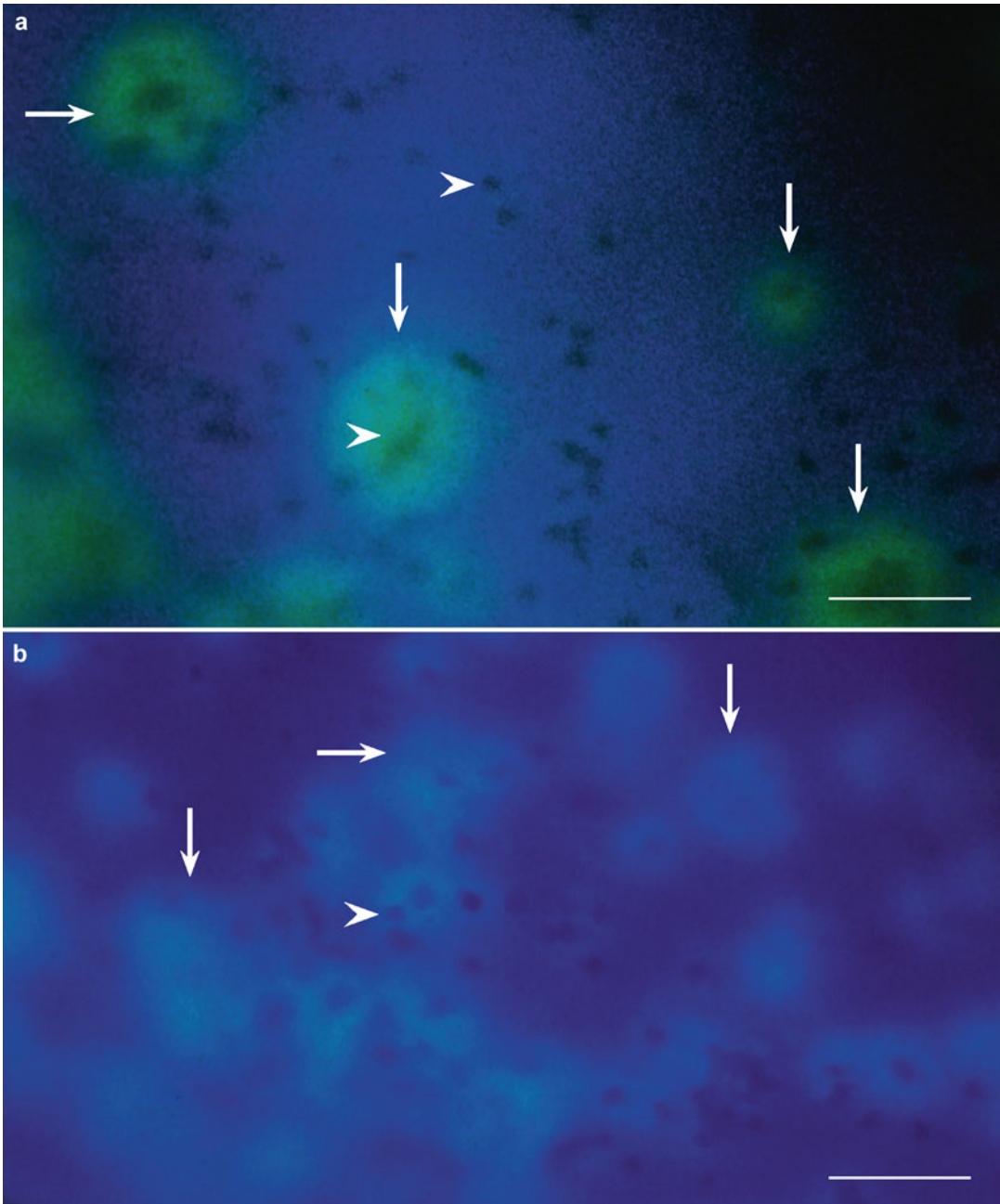


Fig. 2.12 (a, b) Fluorescent flecks (arrows) and non-fluorescent stained surface cells (arrowheads). (a) With the *green filter*, the cells are visible both within the flecks and outside them. (b) With the *blue filter*, the

cells are well visible against the bright background created by the flecks but difficult to discern outside them. Also in these photographs is visible the propensity to confluence of the flecks. Cf. also Figs. 2.13 and 2.14

Fluorescent Flecks and Colour Filters (2)

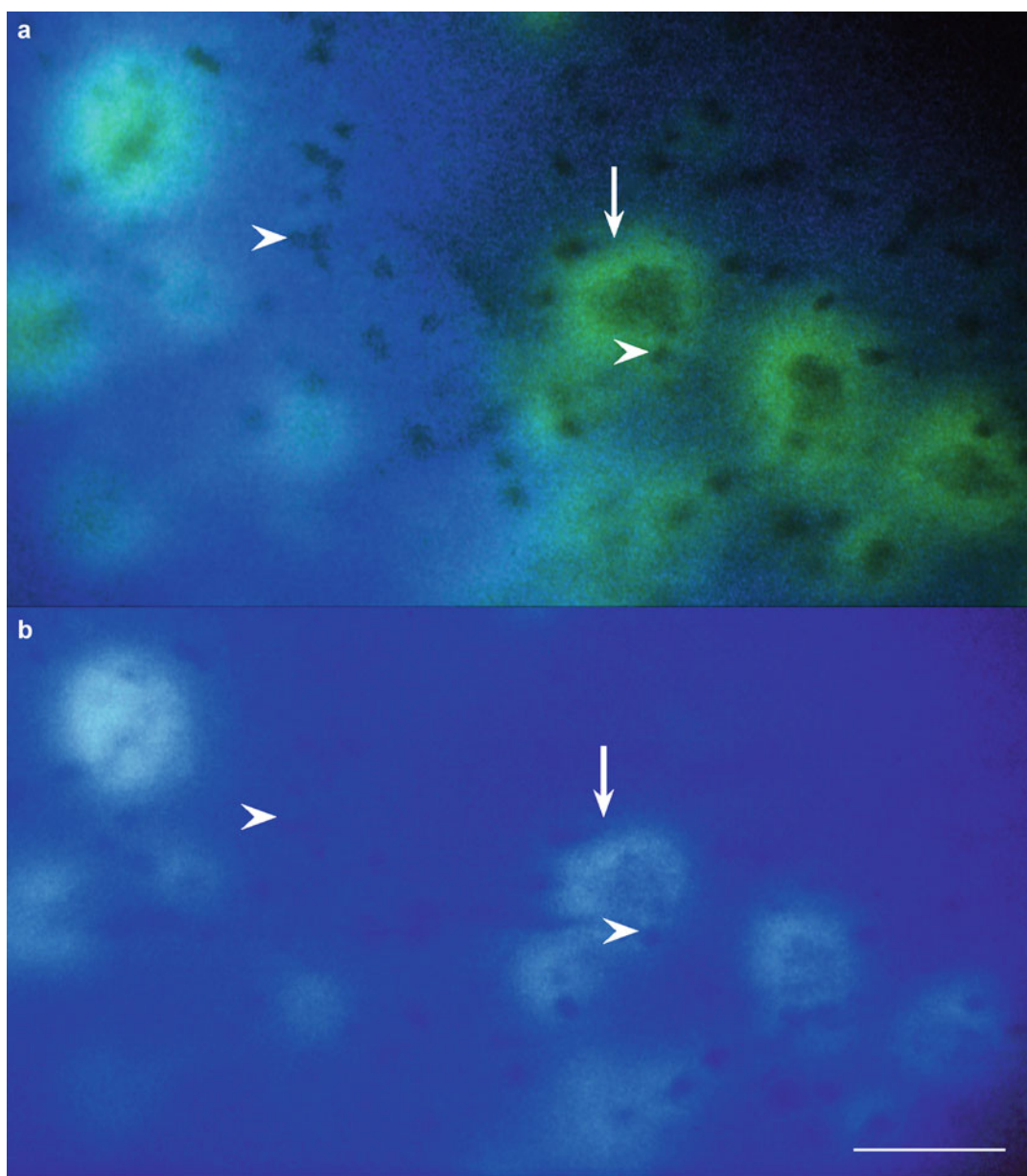


Fig. 2.13 (a, b) The same area showing fluorescent flecks (arrows) and non-fluorescent stained surface cells (arrowheads) captured with (a) the green and (b) the blue filter. The cells outside the flecks are better visible with the green filter. (The markers are placed in corresponding locations)

The Dynamics of Fluorescent Flecks; Stromal Diffusion

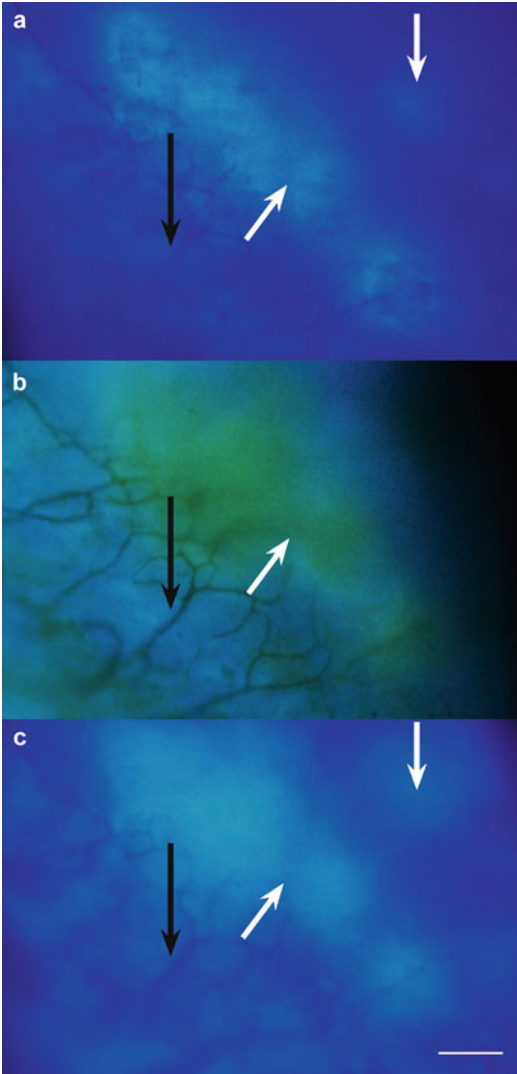


Fig. 2.14 In the strongly light-reflecting limbal area, fluorescent flecks (*arrows*) are better visible with either the blue (**a** and **c**) or the green (**b**) filter than in white light. The flecks enlarge with time and show propensity to confluence. The depth of fluorescein diffusion into the tissues cannot be estimated except for corneal areas in which an optical section can be created (cf. Fig. 2.15). The *black arrows* indicate limbal vessels. (The arrows are placed in corresponding locations)

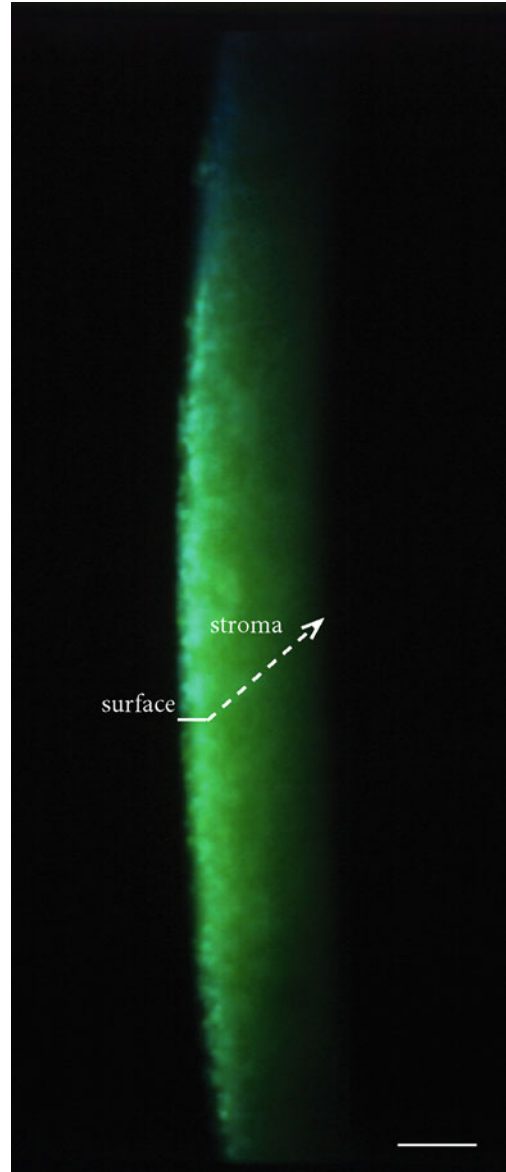


Fig. 2.15 Optical section of a cornea in which fluorescein has penetrated deeply into the stroma

Rose Bengal Staining of Surface Cells

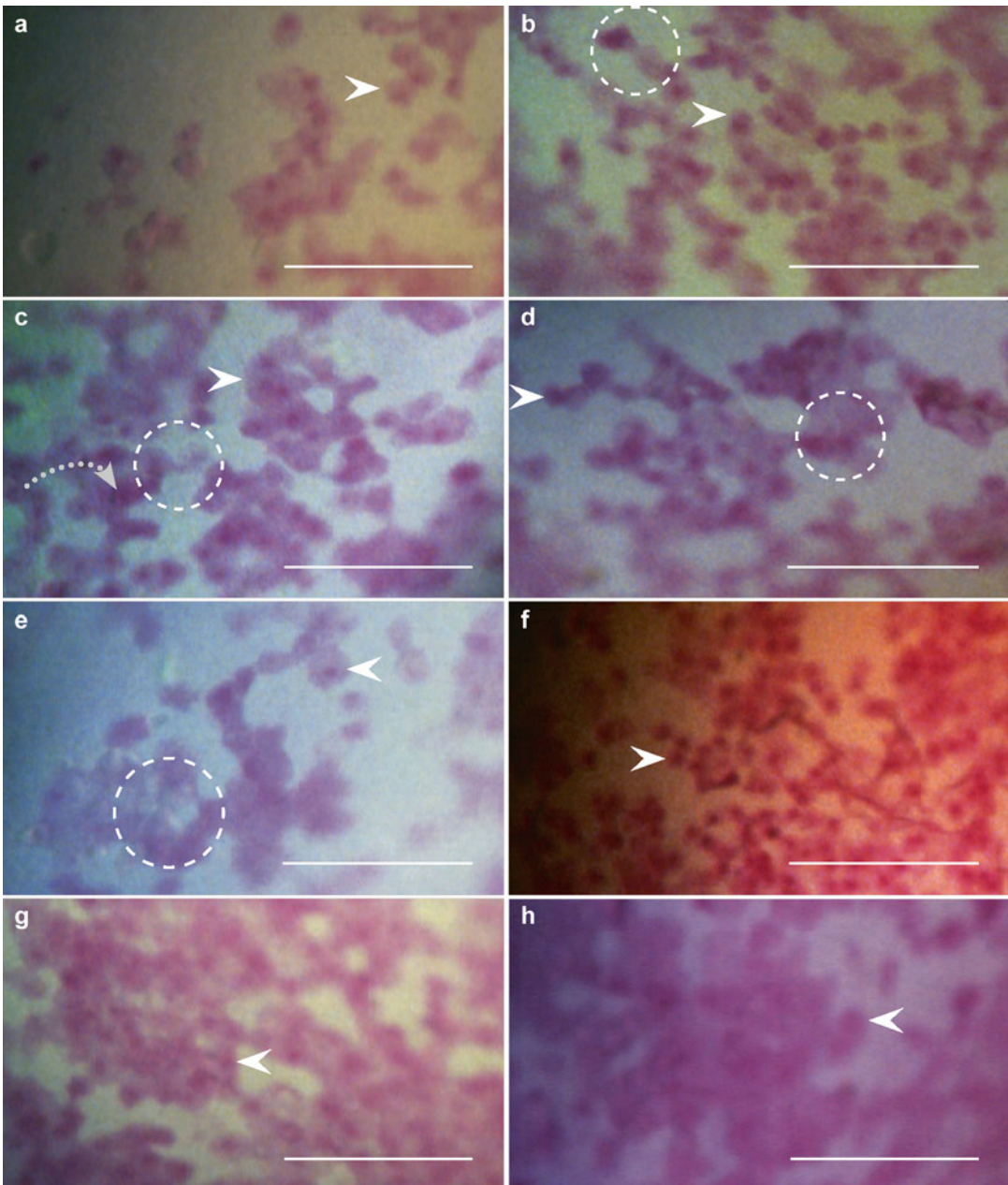


Fig. 2.16 (a–h) Various large rose bengal stained surface cells (*arrowheads*), individual, in rows and groups. The staining densities and hues vary not only with illumination but also in cells in apposition, i.e. under approximately same illuminating conditions

(b–e, *frames*). Some cells show darkly stained dots (nuclei). In places, the staining is confluent. Some of the more deeply red stained spots (c, *arrow*) are probably caused by mucus adhering to the surface (cf. Fig. 2.22)

Dynamics of Rose Bengal Stained Cells

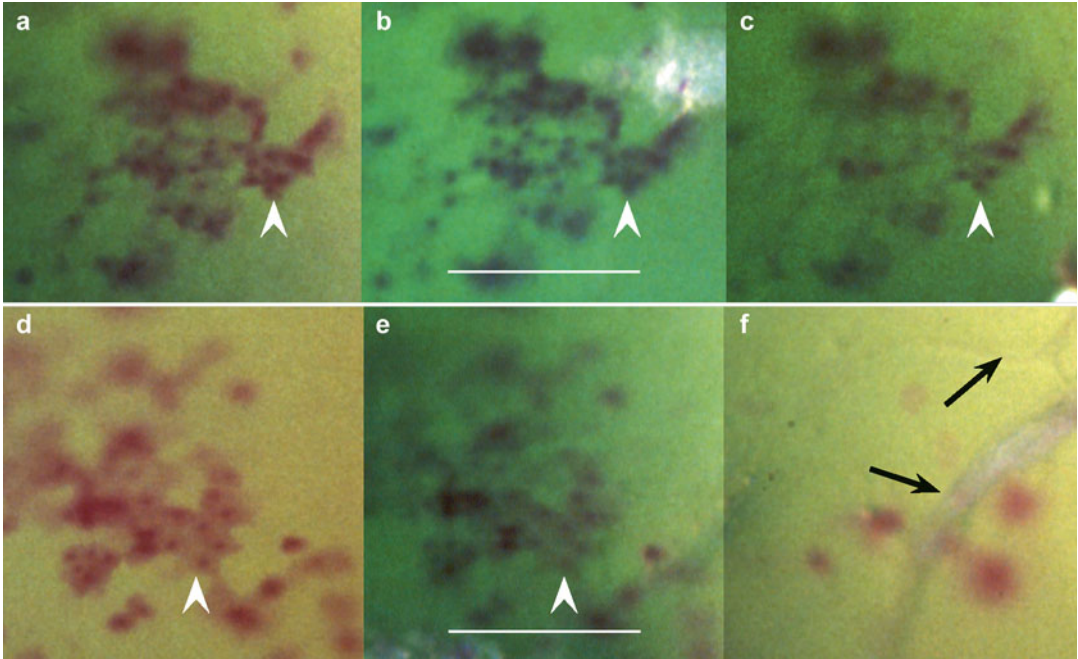


Fig. 2.17 (a–c) A group of rose bengal stained cells (*arrowheads*) in time sequence: (a) and (b) seem identical but in (c) many of the dark dots (nuclei) have disappeared. (d, e) Another area of the same cornea

appears unchanged. In (f) are additionally visible mucus threads (*arrows*). (The arrowheads in a–c and in d and e are placed in corresponding locations)

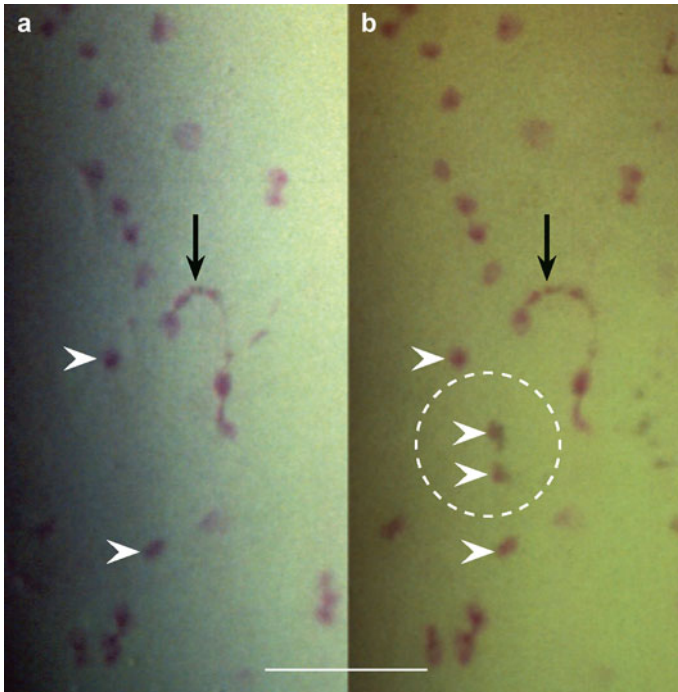


Fig. 2.18 (a, b) Two consecutive photographs of the same area. The patterns of rose bengal stained surface cells (*arrowheads*) are almost the same; in the area indicated by *frame* in (b) two new rose bengal stained cells appeared during the time elapsing between (a) and (b). The curvature of the thread (*arrows*), attached at each end to a rose bengal stained cell and forming a bow, has slightly changed. (The markers are placed in corresponding locations)

Non-fluorescent Fluorescein Versus Rose Bengal Cell Staining

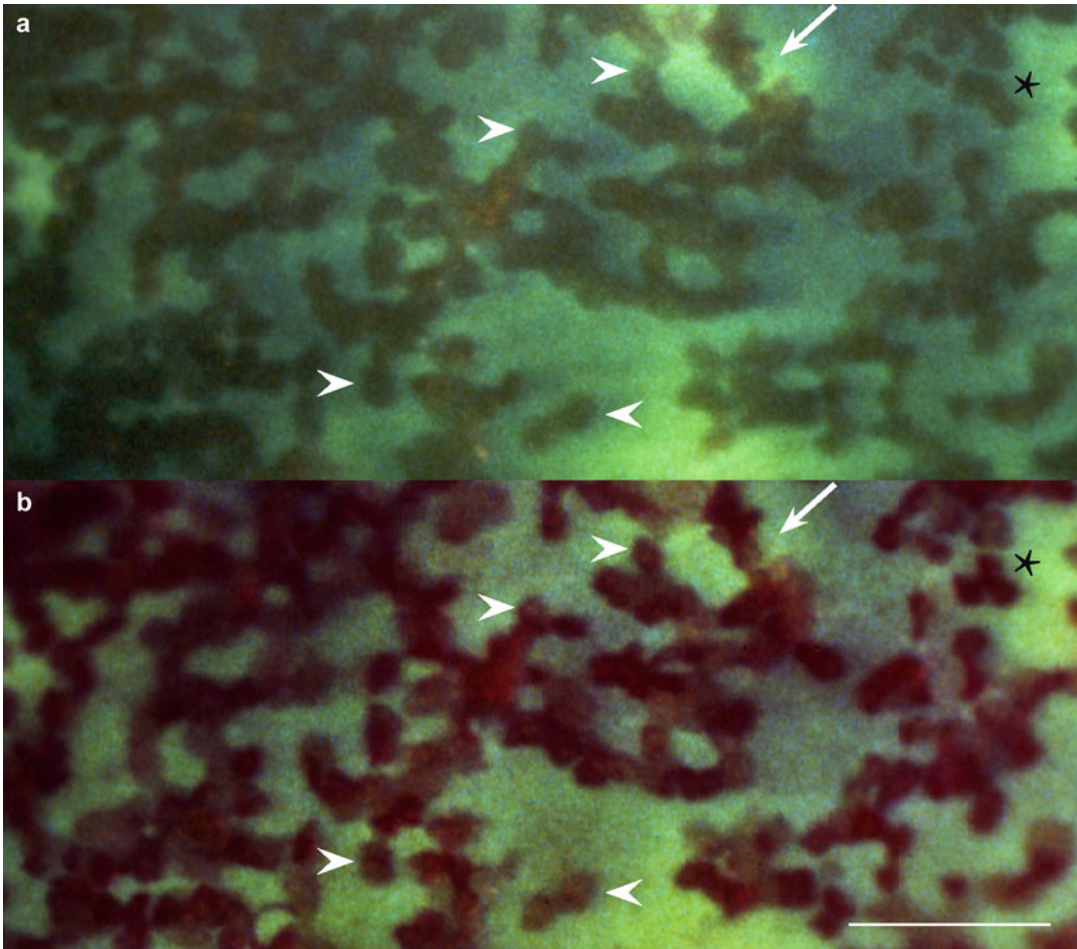


Fig. 2.19 (a) Surface cells (*arrowheads*) stained yellow/brown with non-fluorescent fluorescein. The green fluorescence (*arrow*) reveals fluorescein diffusion into the tissues. (b) The same area with rose bengal added; the red staining pattern of diseased surface cells corresponds

to that in (a) with minor differences caused by displacement of some diseased surface elements (*asterisk*). (The markers are placed in corresponding locations) (Adapted from [9])

Fig. 2.21 Four consecutive photographs. (a) Fluorescent (green) stained dots (*arrowheads*); (b–d) after staining with rose bengal becomes visible that the majority of them represents diseased surface cells (*arrowheads*). In

(b–d) are additionally visible mucus threads (*straight arrows*) and lumps (*bowed arrows*) moving with blinks. (The arrowheads are placed in corresponding locations)

Punctate Fluorescent Fluorescein Versus Rose Bengal Cell Staining

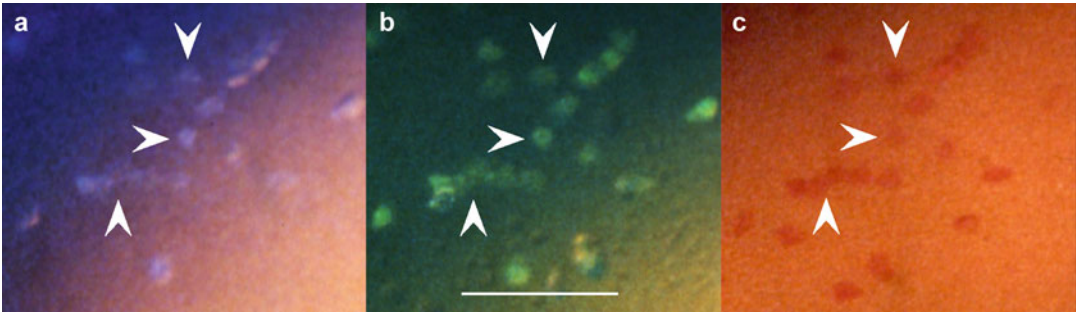
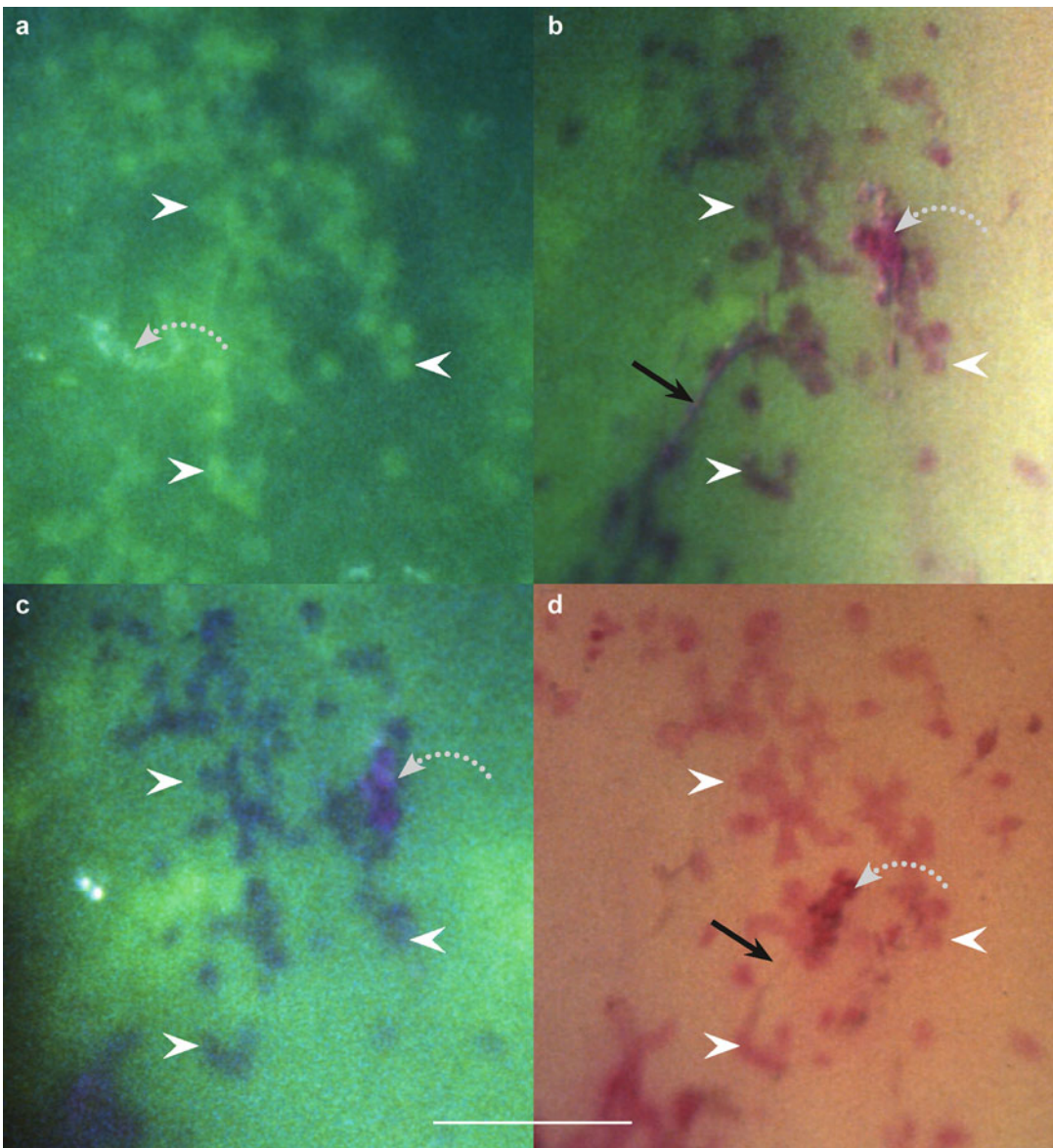


Fig. 2.20 (a) Greyish surface cells (*arrowheads*) stained (b) green with fluorescein and (c) red with rose bengal (The arrowheads are placed in corresponding locations)



Mucus Adhering to Surface Cells

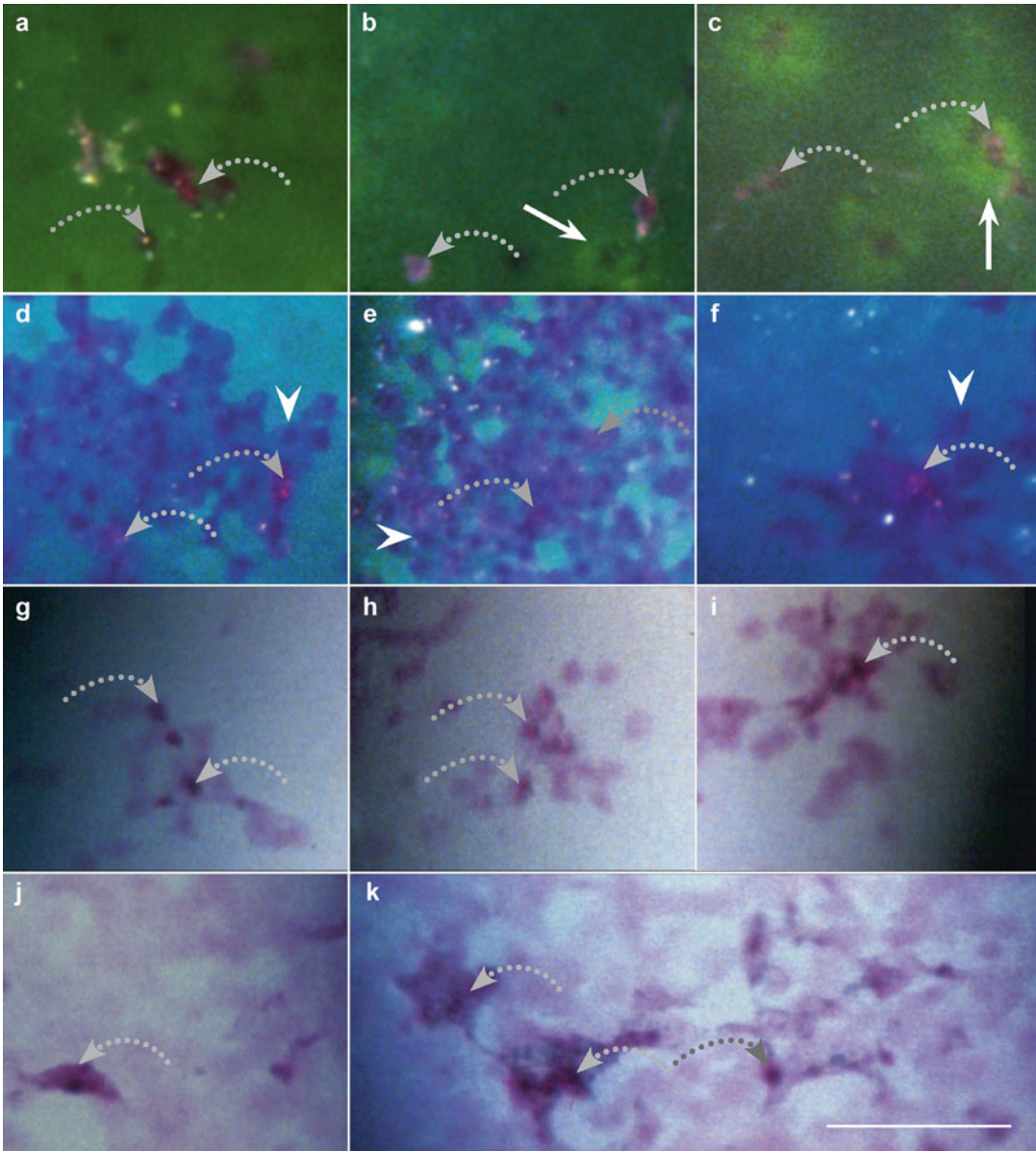


Fig. 2.22 The appearance of small rose bengal stained patches of mucus adhering to surface cells (*bowed arrows*) depends on illumination. It appears (*a–f*) brighter than its surroundings in focal illumination; the contrast between mucus and surface cells (*arrowheads*)

staining is particularly well visible in (*d–f*). (*g–k*) The red stained mucus appears darker than its surroundings in retroillumination (cf. also Fig. 2.23). In (*b, c*) are additionally visible green flecks caused by fluorescein diffusion into the tissues (*straight arrows*)

Mucus Threads and Strands Adhering to the Surface

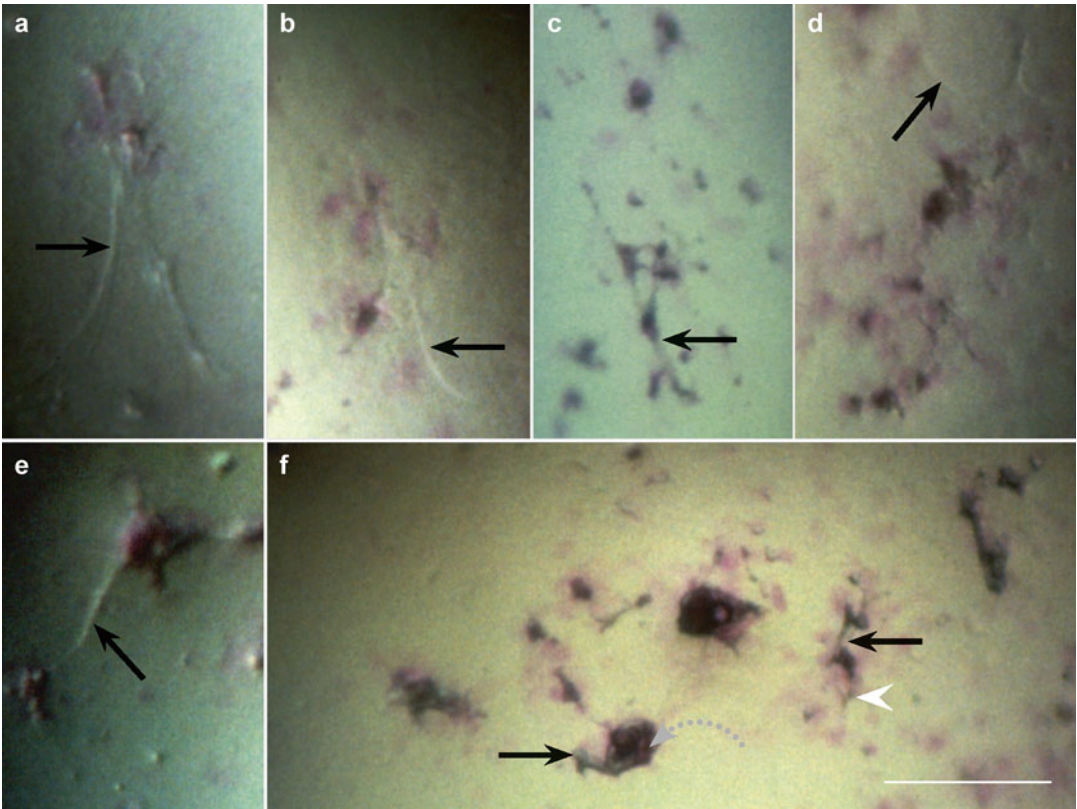


Fig. 2.23 (a–e) The curved shapes of these mucus strands (*arrows*) imply an at least partial surface attachment; in (d) the curved line (*arrow*) is suggestive of an edge of a surface-attached sheet (cf. Fig. 2.24). (f) The

short threads (*straight arrows*) with attached material (*bowed arrow*) may be moving in the tear film but for the moment they seem to adhere to rose bengal stained surface cells (*arrowhead*)

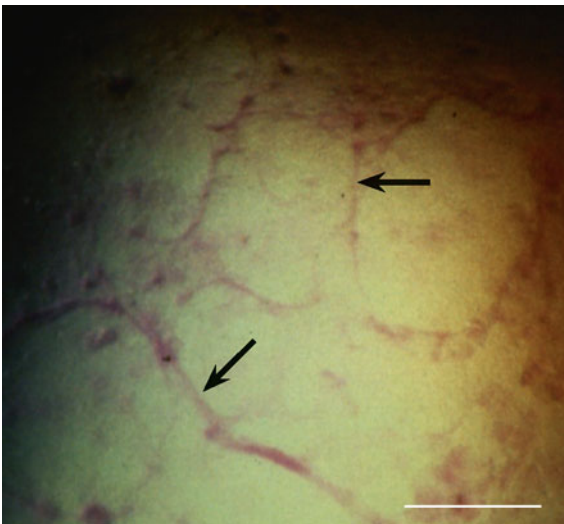


Fig. 2.24 These thicker and thinner curved rose bengal stained strands (*arrows*) seem to be rolled-up edges of a sheet adhering to the surface. (For additional examples, see Figs. 4.7–4.11)

Surface Mucus 'Plaques' and Their Dynamics (1)

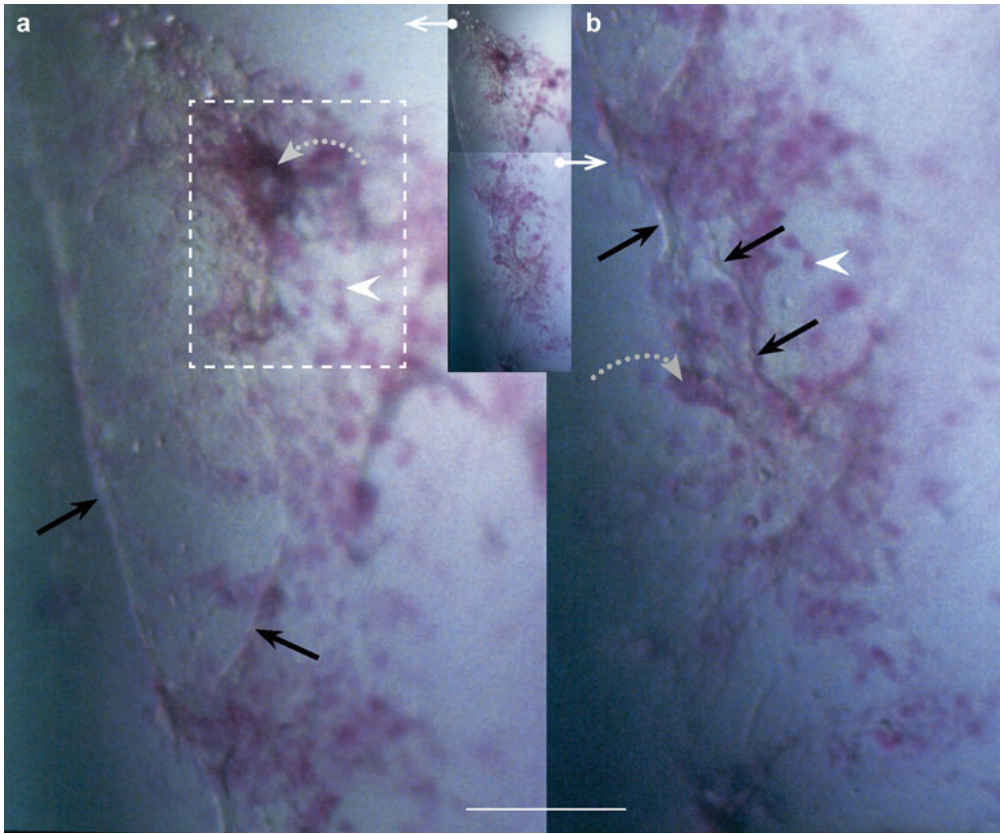


Fig. 2.25 Inset: survey of a larger mucus 'plaque'; (a) shows its upper and (b) its lower part at higher magnification. The mucus is visible as bowed lines (straight arrows) and small densely rose bengal stained

areas (bowed arrows); the arrowheads indicate rose bengal stained cells. The dynamics of the area in frame is shown in Fig. 2.27 (opposite page)

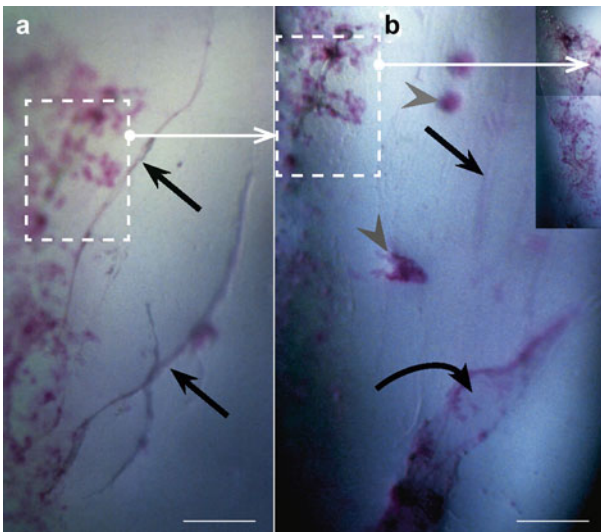


Fig. 2.26 Inset in (b): the same mucus 'plaque' as in Fig. 2.25. In (a, b) are visible mucus strands and threads (straight arrows), a crumpled mucus sheet with adhering material (b, bowed arrow) and lumps of material (b, arrowheads), all appearing and disappearing during the examination. The frames in (a, b) indicate the same area, shown at higher magnification in Fig. 2.28

Surface Mucus 'Plaques' and Their Dynamics (1) (cont.)

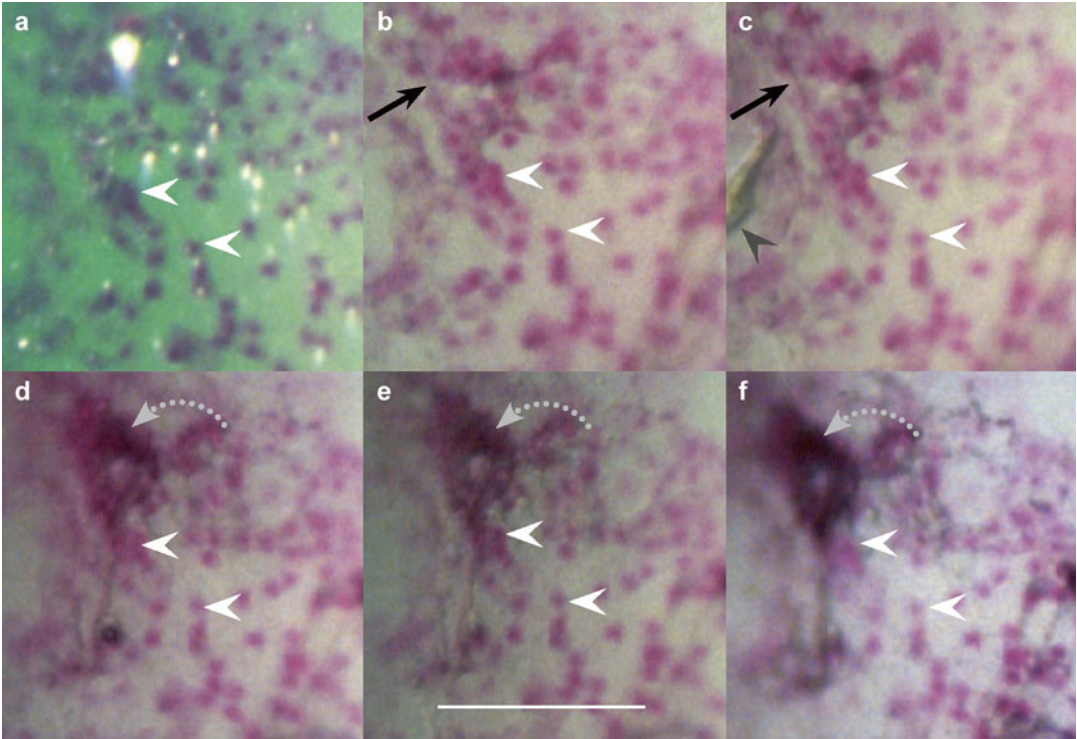


Fig. 2.27 Sequence of events occurring in the area indicated by frame in Fig. 2.25. (a–c) The white arrowheads indicate rose bengal stained surface cells and the straight arrows in (b, c) a thin mucus thread. The cell patterns appear identical in all three photographs. In

(c) has appeared a lump of material (grey arrowhead). (d–f) show a newly attached piece of mucous material (bowed arrows) that remains in place. (The markers are placed in corresponding locations, the white arrowheads throughout the series)

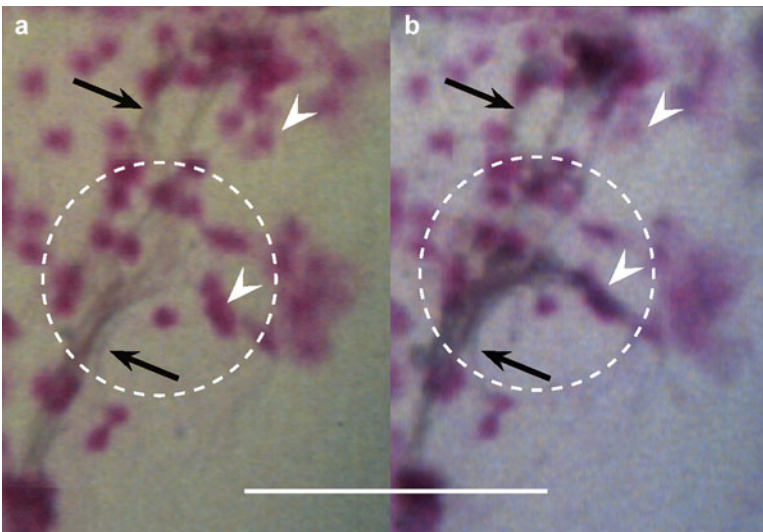
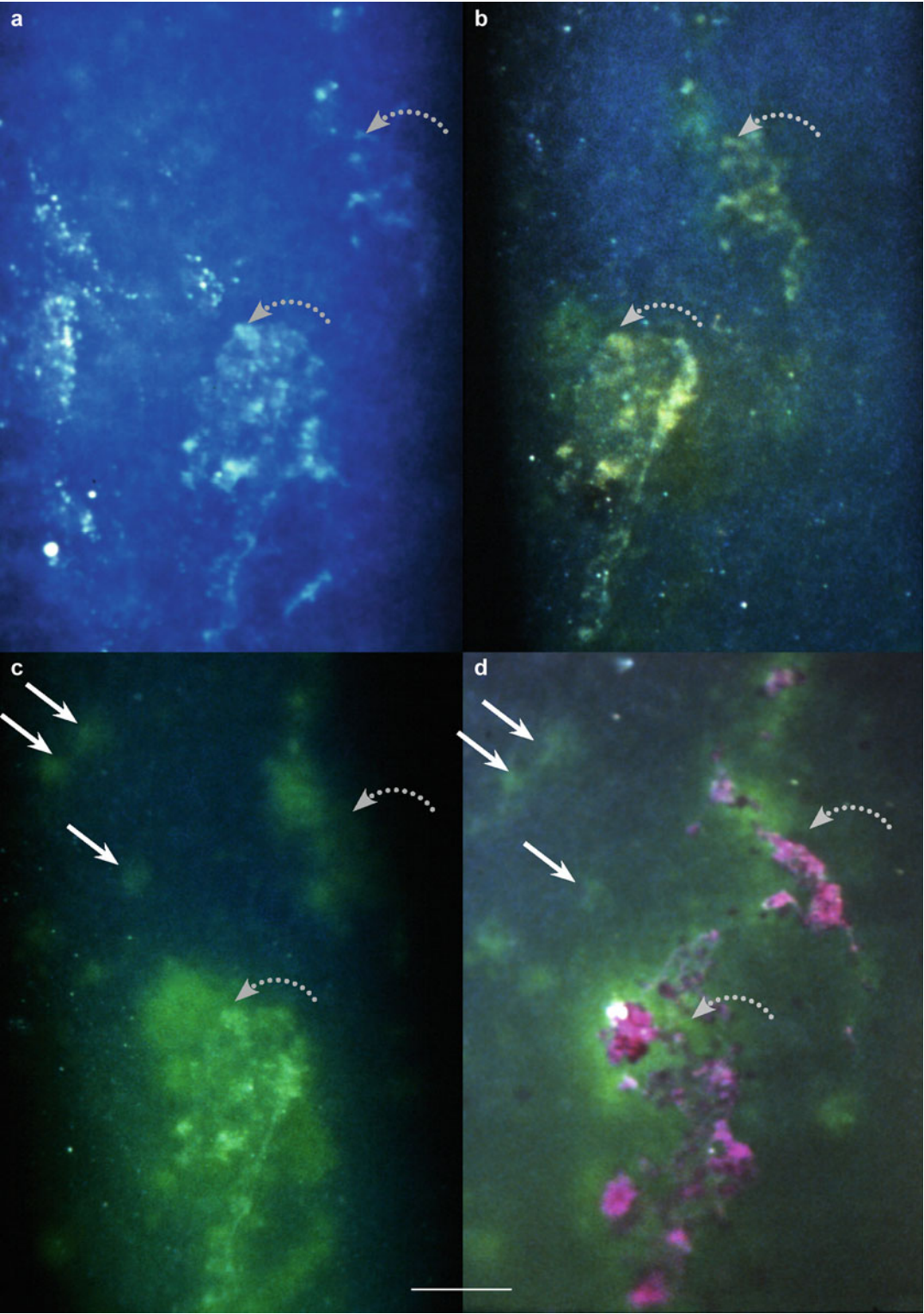


Fig. 2.28 The area indicated by frames in Fig. 2.26.

(a, b) The arrows point to mucus threads and the arrowheads to rose bengal stained cells. Only minor changes (in frame) have occurred during the time elapsing between the two photographs. (The markers are placed in corresponding locations)

Surface Mucus 'Plaques' and Their Dynamics (2)



Surface Mucus 'Plaques' and Their Dynamics (2) (cont.)

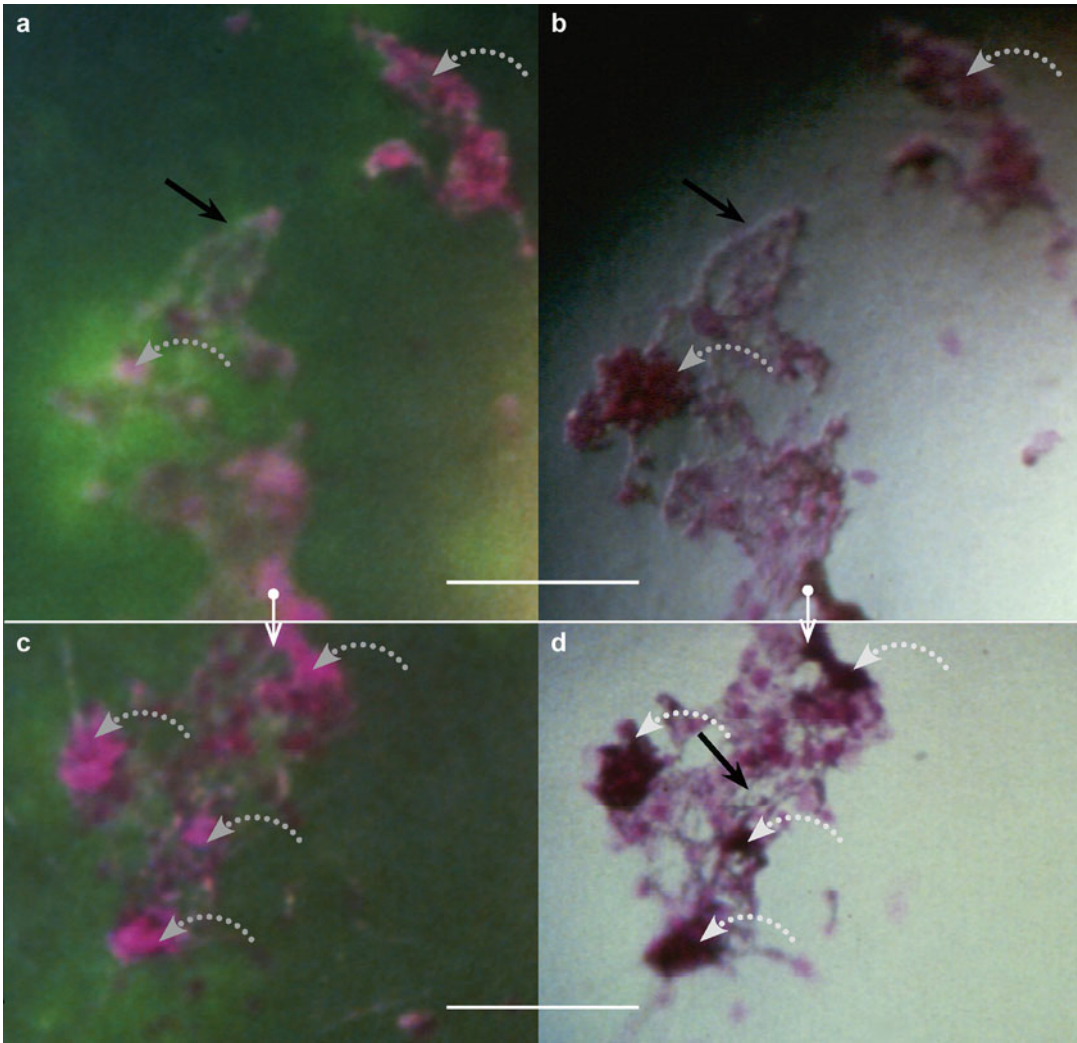


Fig. 2.30 (a, b) The upper and (c, d) the lower part of Fig. 2.29d. The bowed arrows indicate pieces of surface-adherent mucus, brightly red/pink in focal (a and c) and dark (b and d) in retroillumination. The straight

arrows indicate mucus strands and threads. The patterns are similar but not identical because of changes occurring with blinks. (The markers are placed in corresponding locations in each pair of the photographs)

Fig. 2.29 (a) Before staining are visible areas (bowed arrows) containing strongly light-reflecting patches, lines and dots. (b) Early after the application of fluorescein appears green staining caused by fluorescein diffusion into the tissues in these areas (bowed arrows). Later on (c) the green staining appears more brilliant; the straight arrows indicate small fluorescent (green)

flecks. (d) After the application of rose bengal, there is a new pattern showing brightly red/pink stained mucus adhering to green flecks (bowed arrows), in (a–c) placed in corresponding locations and in (d) placed with the small green flecks serving as (very approximate) reference points; some details are shown in Fig. 2.30; cf. also Fig. 5.24

Fluorescent Fluorescein and Rose Bengal Staining in Combination. Example 1

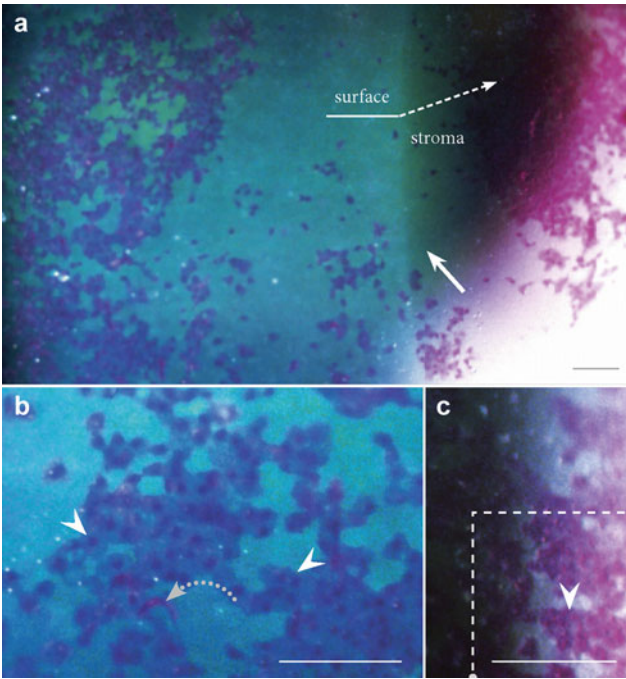


Fig. 2.31 (a) Survey. Heavy rose bengal staining, in the left part of the picture seen against green background caused by fluorescein diffusion (arrow) into the tissues, and in the right one in light reflected from the iris (cf. Fig. 4.19); the hue varies with background illumination. (b) Of the variously large cells (arrowheads), many show a distinct dark dot (nucleus); attached mucus (arrow) appears brightly red/pink. (c) In an area of heavy staining, cell nuclei (arrowhead) are difficult to discern. The area in frame is shown in Fig. 2.32

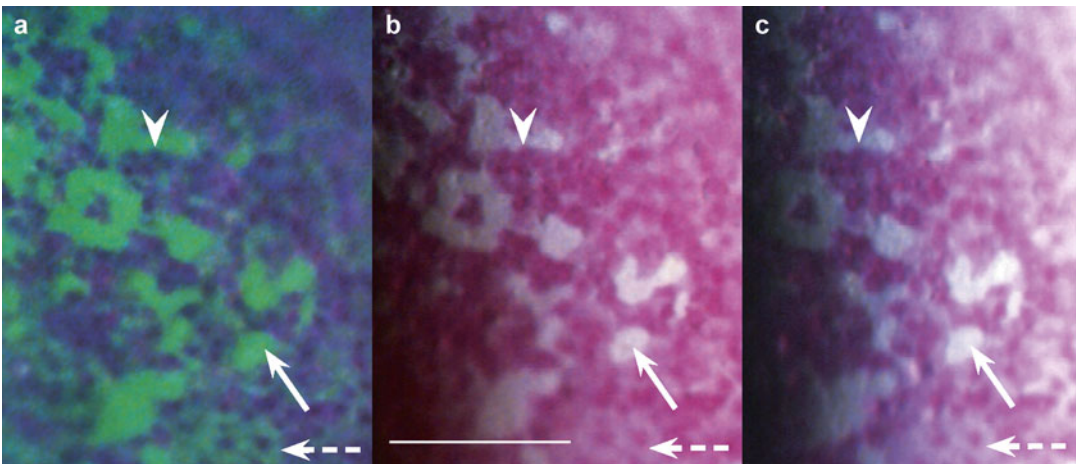


Fig. 2.32 The area in frame in Fig. 2.31. In areas showing heavy rose bengal staining, (a) darker dots (nuclei, arrowheads) are well discernible against green background but (b, c) more difficult so against a deeply red one. The brightly green hue of fluorescein diffusing

into the tissues (a, plain arrow) indicates an absence of (discernible) rose bengal staining (cf. b, c) and its dirty hue (a, dashed arrow) a week one (cf. b, c). (The markers are placed in corresponding locations)

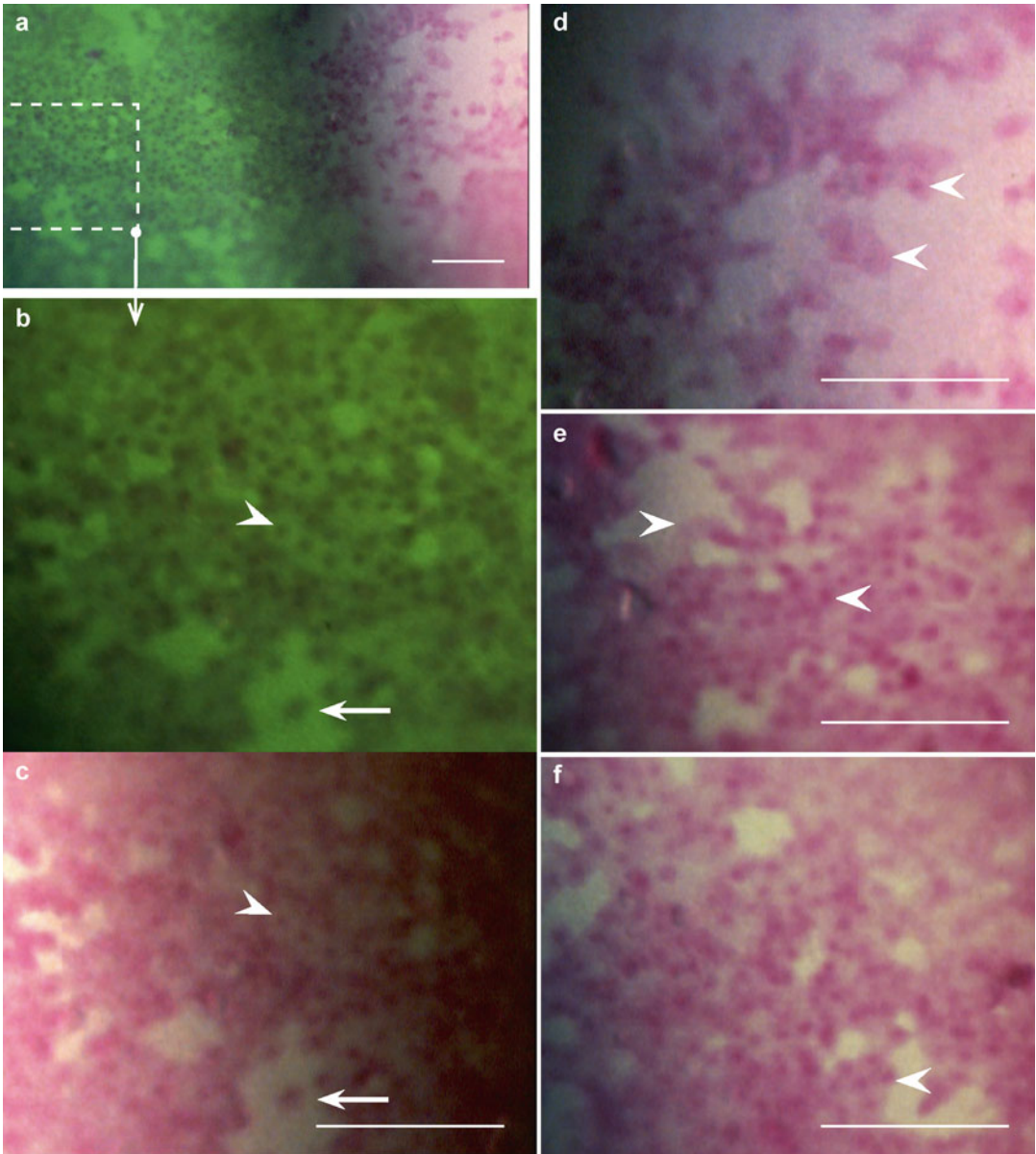
Fluorescent Fluorescein and Rose Bengal Staining in Combination. Example 2

Fig. 2.33 (a) Survey of an area showing fluorescein diffusion (green) into the tissues and many rose bengal stained surface cells. (b) The area in *frame* in (a) shows rows of smaller and larger rose bengal stained surface cells (*arrowhead*) in apposition and green stained in-between areas (*arrows*). (c) The same area as in (b); the

green staining is not visible in retroillumination. (The markers are placed in corresponding locations.) (d–f) Different areas of the same cornea showing smaller and larger rose bengal stained surface cells (*arrowheads*), some with and others without a deeply red stained dot (nucleus)

Surface Changes Captured in the Same Cornea at the Same Occasion

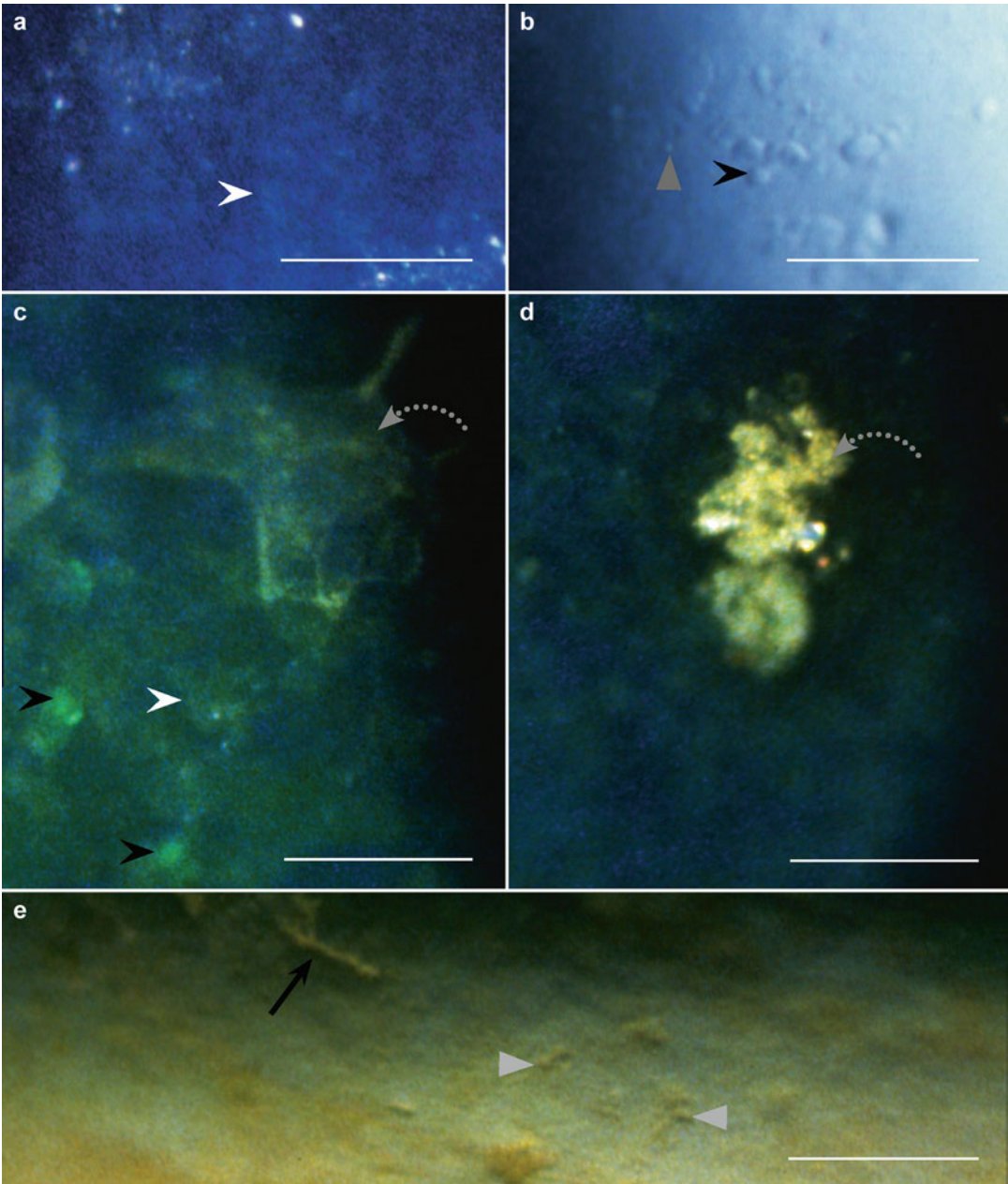


Fig. 2.34 Before staining, the cornea shows (a) greyish surface cells (*arrowhead*) and bright light-reflecting dots and (b) cystic spaces (*black arrowhead*) and rounded bodies (*grey arrowhead*). Shortly after the application of fluorescein is visible (c) a weak green staining revealing surface cells (*white arrowhead*) and a

brilliantly green one indicating cystic spaces (*black arrowheads*); the *arrows* indicate (c) a flat mucus sheet and (d) a crumpled one. In (e), the *arrow* indicates a mucus strand and the *arrowheads* rounded bodies; in this illumination, fluorescein staining appears yellow

Surface Changes Captured in the Same Cornea at the Same Occasion (cont.)

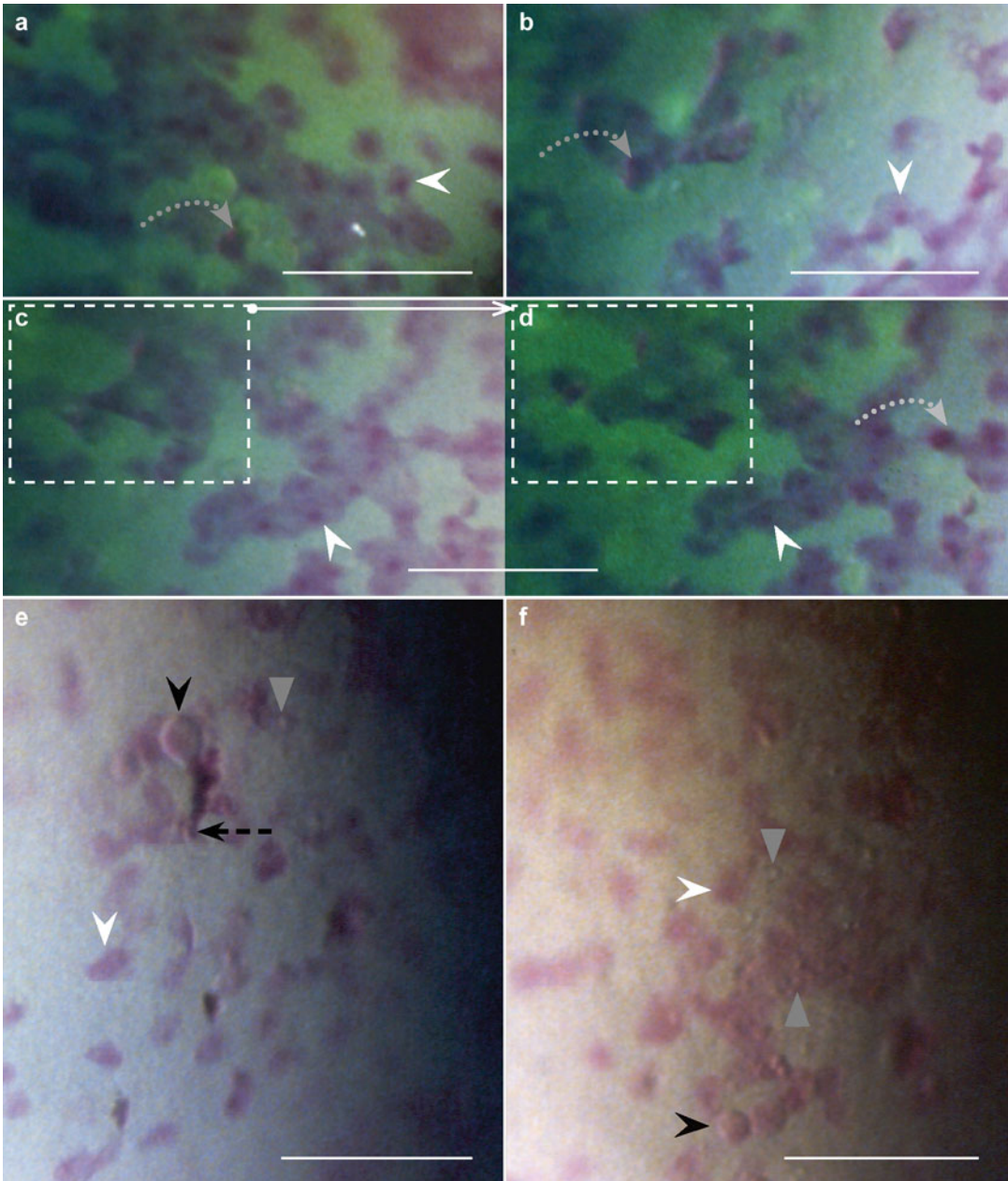


Fig. 2.35 (a–d) Rose bengal stained surface cells (arrowheads), with or without deeply red stained dots (nuclei), and mucus adhering to some of the cells (arrows). (c, d) show the same area; the arrow in (d) indicates surface mucus not visible in (c) and the frames highlight some other changes occurring during the

examination. (The arrowheads in c and d are placed in corresponding locations.) (e, f) In these areas are visible rose bengal stained cells (white arrowheads) lacking deeply stained dots (nuclei), cystic spaces (black arrowheads), rounded bodies (grey arrowheads), and a small filament (arrow)

Epithelial Infiltrates (?)

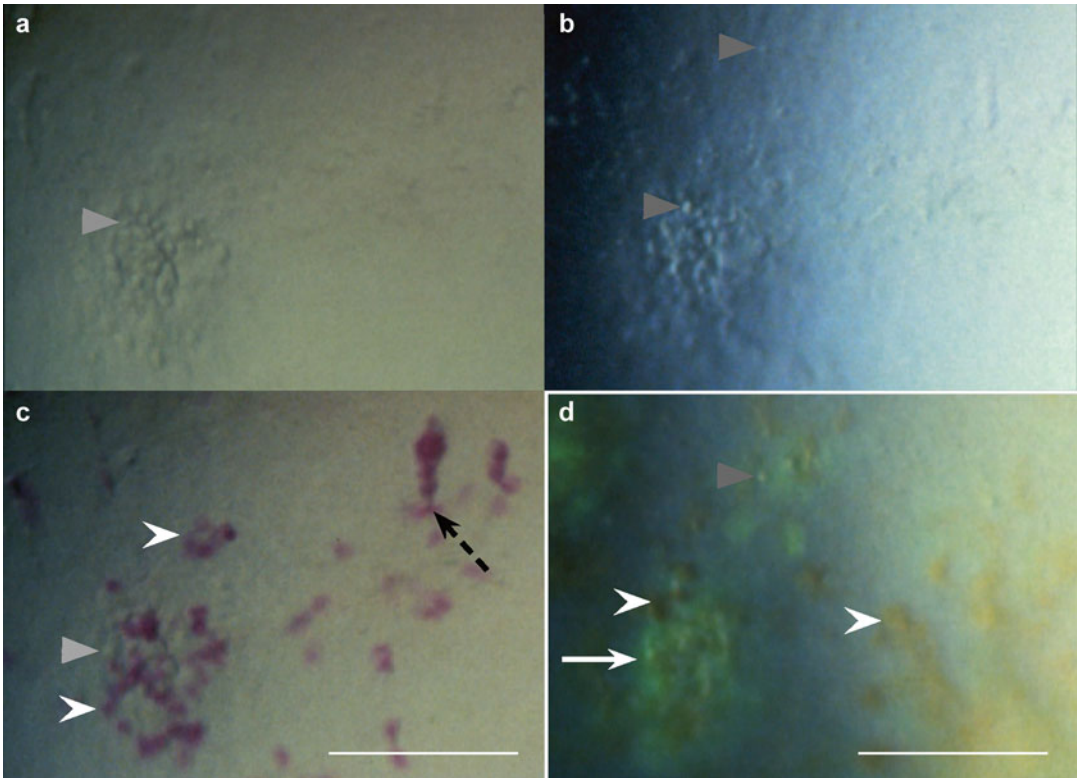


Fig. 2.36 (a–c) The same area. Rounded bodies (*grey arrowheads*) and rose bengal stained surface cells (*white arrowheads*), individual or grouped; the *dashed arrow* in (c) indicates attachment point of a small filament. (d) A small fleck, showing fluorescein diffusion into the

tissues (green, *white arrow*); yellow-brown (non-fluorescent) stained surface cells (*white arrowheads*) are present within the fleck and outside it, rounded bodies (*grey arrowhead*) are visible outside it (cf. Fig. 4.1)

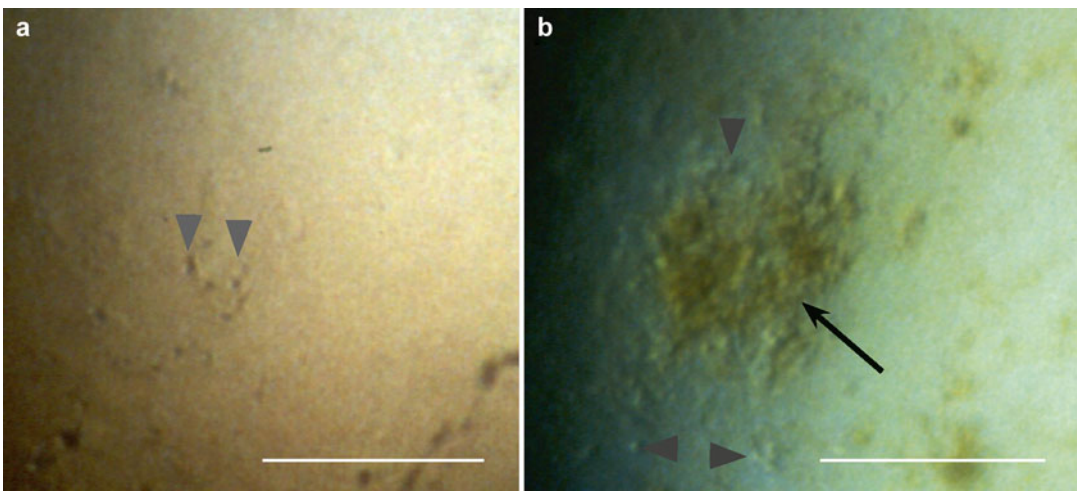


Fig. 2.37 (a) Rounded bodies (*arrowheads*), spread on the surface and (b) concentrated in a small area (*arrow*); the latter reminds of epithelial infiltrates (such as

occurring in the acute stage of adenovirus infection and in Thygeson's superficial punctate keratitis)

Fluorescent Flecks (2, Additional Features)

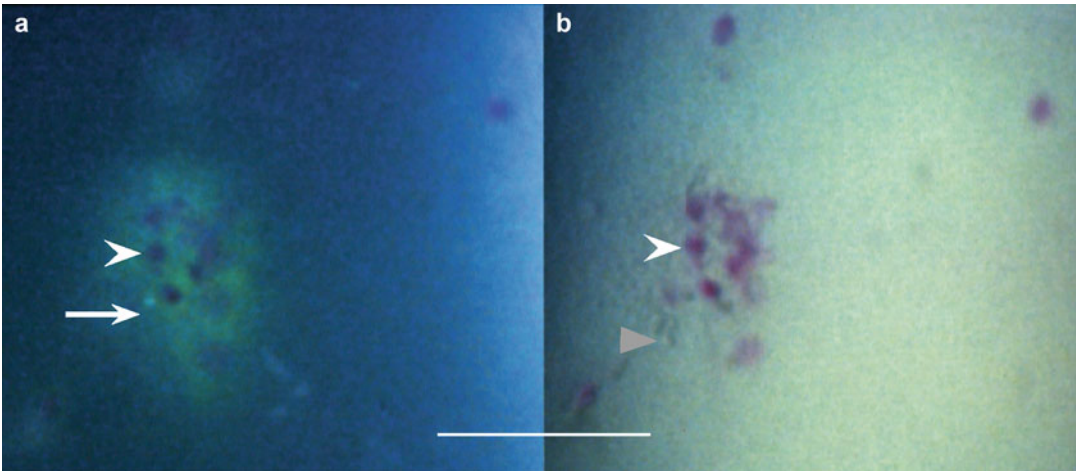


Fig. 2.38 (a, b) A small fleck showing fluorescein diffusion into the tissues (*arrow*) and rose bengal stained surface cells (*white arrowhead*). In (b) are visible

rounded bodies (*grey arrowhead*). (The white arrowheads are placed in corresponding locations)

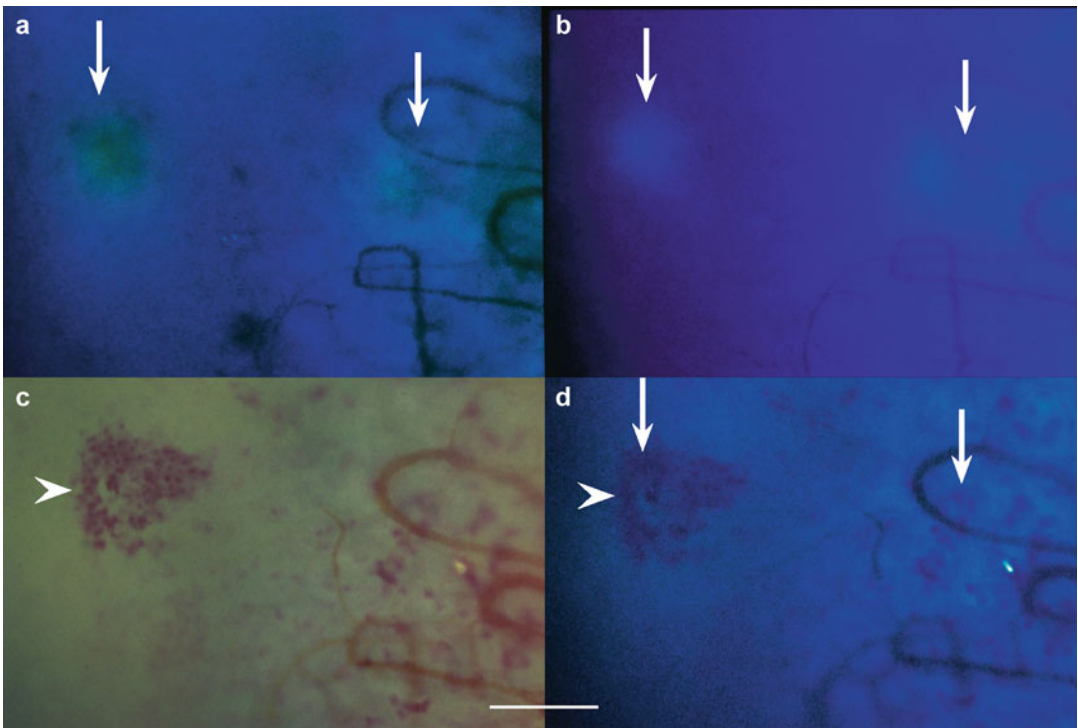


Fig. 2.39 Small corneal flecks (*arrows*) close to the limbus visualised with (a) fluorescein and green filter, (b) fluorescein and blue filter, (c) rose bengal in white light and (d) rose bengal and green filter.

Where non-fluorescent (dark, yellow) fluorescein staining (a) is present, rose bengal staining (c, d) can be expected. (The markers are placed in corresponding locations)

Fluorescent Flecks (2, Additional Features) (cont.)

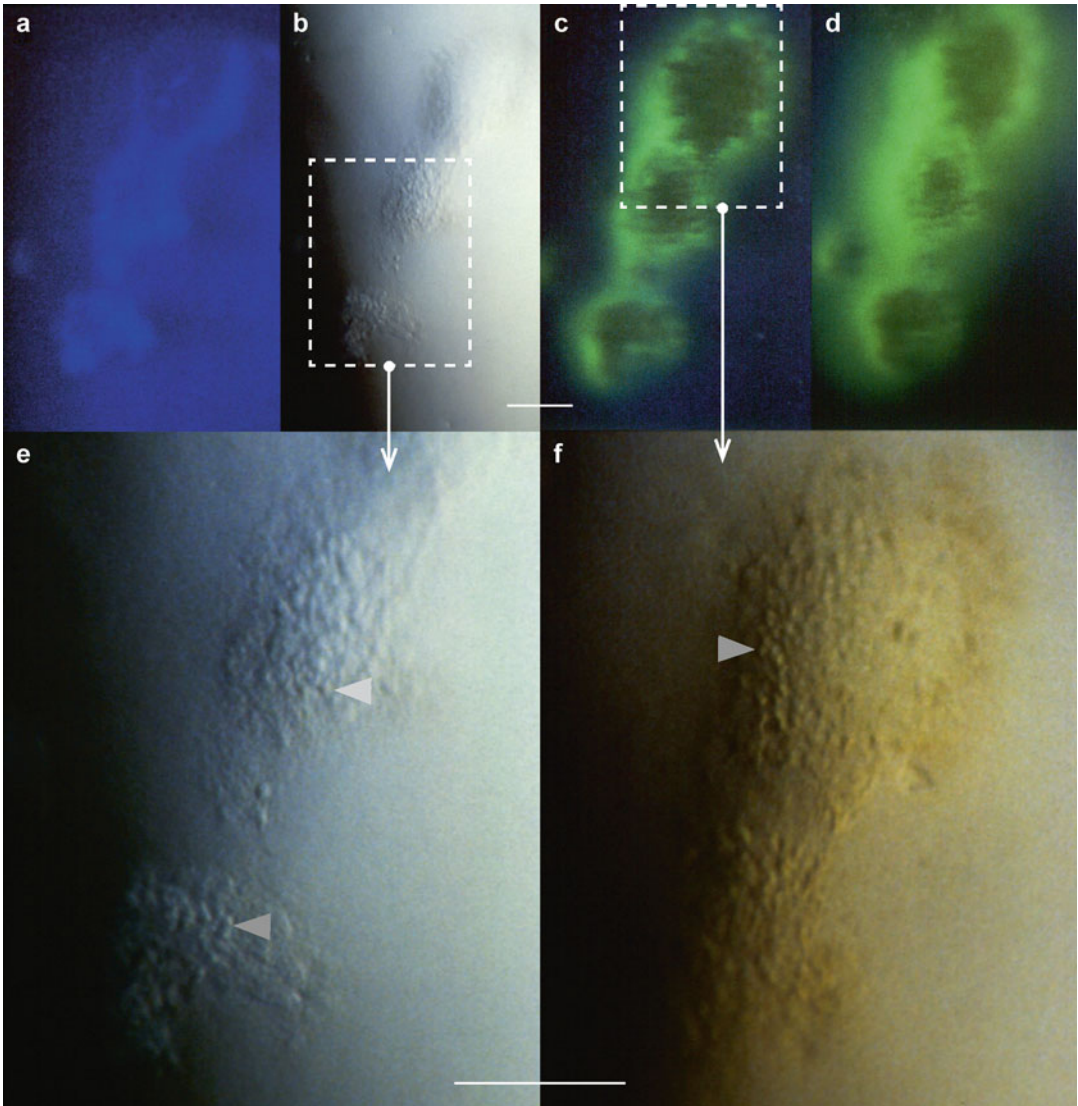


Fig. 2.40 (a–d) This figure with undulating borders is (a) partly light-reflecting, (b) appears granular, (c) shows a non-fluorescent (dark) and a fluorescent (green) staining, caused by fluorescein diffusion into the tissues, which (d) enlarges with time. In all photographs is

visible that the shape of the fleck is a result of confluence of smaller lesions. The areas in *frames* are shown at higher magnification in (e, f); in both are visible rounded bodies (*arrowheads*) (cf. Figs. 2.48, 4.12, 4.15, and 4.17)

Fluorescent Flecks (2, Additional Features) (cont.)

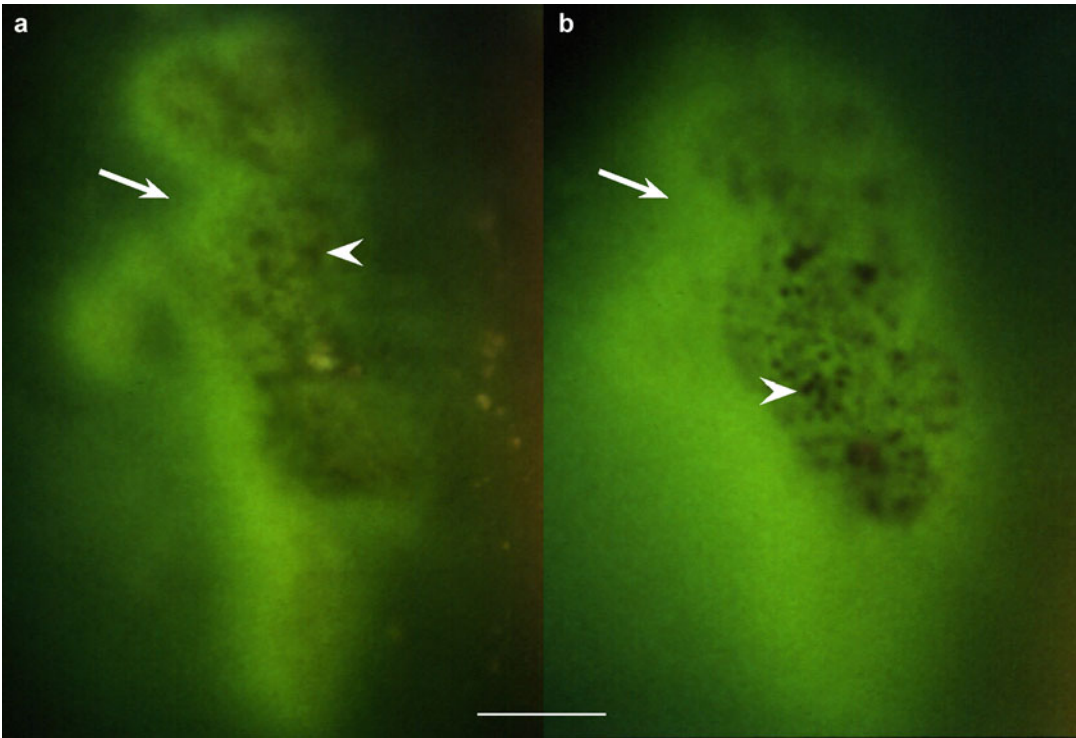


Fig. 2.41 A fleck showing (a) non-fluorescent stained surface cells (*arrowhead*) and (b) rose bengal stained ones (*arrowhead*). The undulating borders in (a) imply

a result of confluence of several flecks (cf. Fig. 2.40). The area of green staining (*arrows*) caused by fluorescein diffusion into the tissues enlarges with time

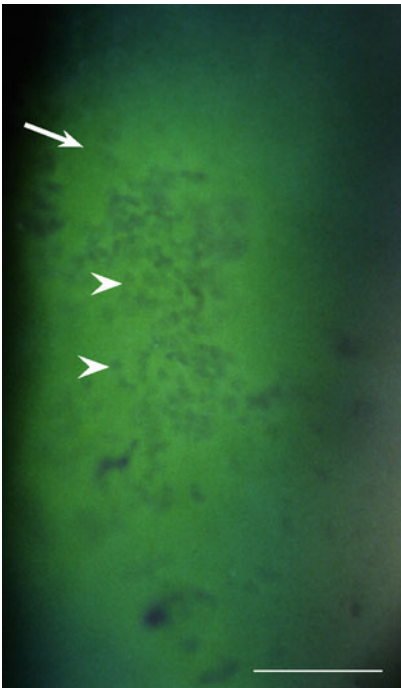


Fig. 2.42 The extensive fluorescein diffusion into the tissues (green, *arrow*) implies that this fleck was captured some time after the application of the dye. The *arrowheads* indicate rose bengal stained surface cells

Fluorescent Flecks (2, Additional Features) (cont.)

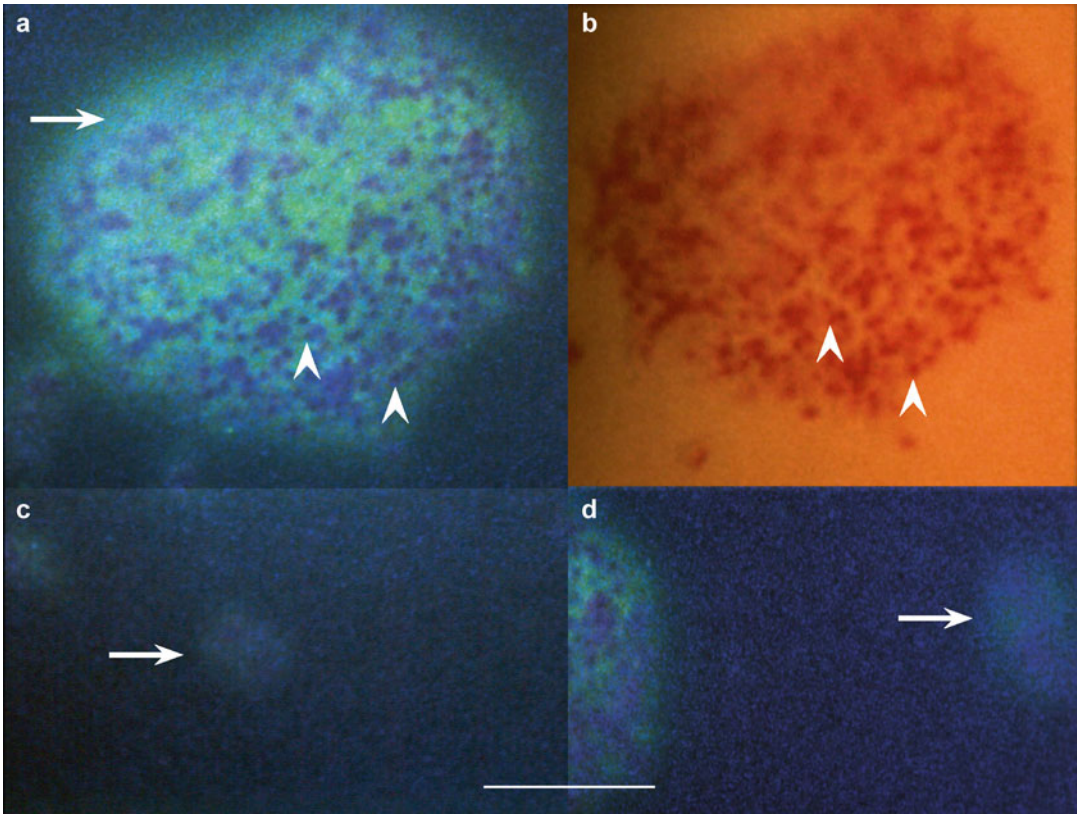


Fig. 2.43 A large rounded fleck showing (a) green fluorescein staining (*arrow*) and (a, b) many small rose bengal stained cells (*arrowheads*). (c, d) Small flecks are present in the surroundings (*arrows*). (The arrowheads are placed in corresponding locations)

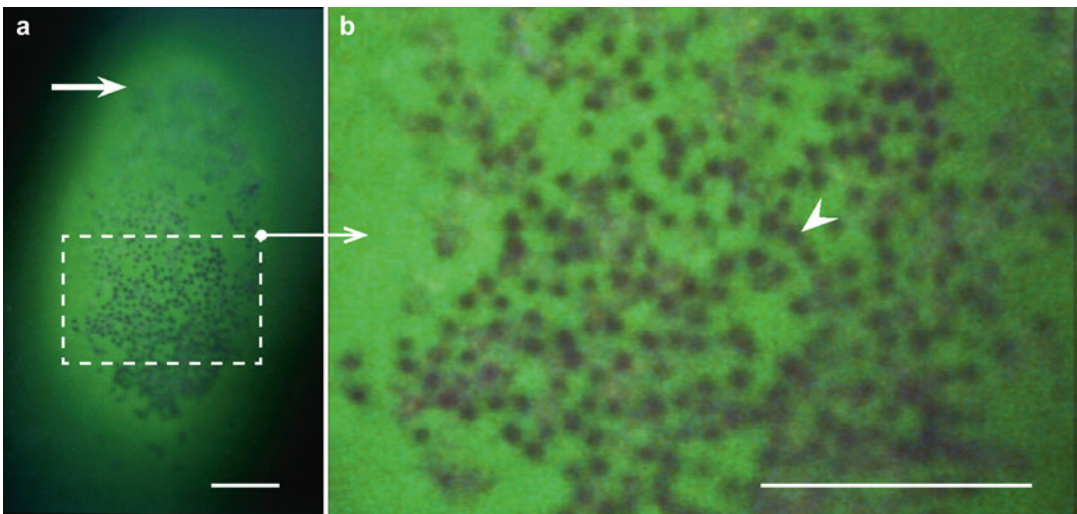


Fig. 2.44 (a) Survey of a large oval fleck. The *arrow* indicates fluorescein diffusion into the tissues. (b) The area in frame in (a) shows many small rose bengal stained cells (*arrowhead*) with distinct dark dots (nuclei)

Fluorescent Flecks (2, Additional Features) (cont.)

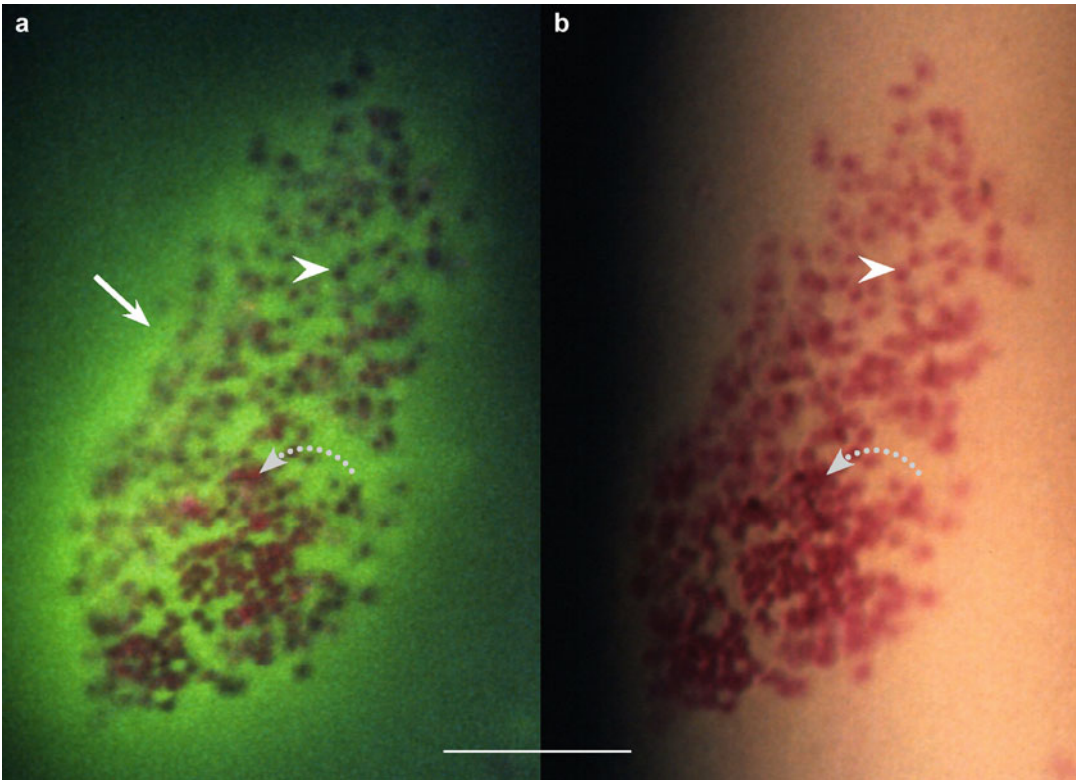


Fig. 2.45 An oval fleck showing (a) fluorescein diffusion into the tissues (green, *straight arrow*) and (a, b) small rose bengal stained nucleated cells (*arrowheads*)

with mucus adhering to some of them (*bowed arrows*). (The markers are placed in corresponding locations)

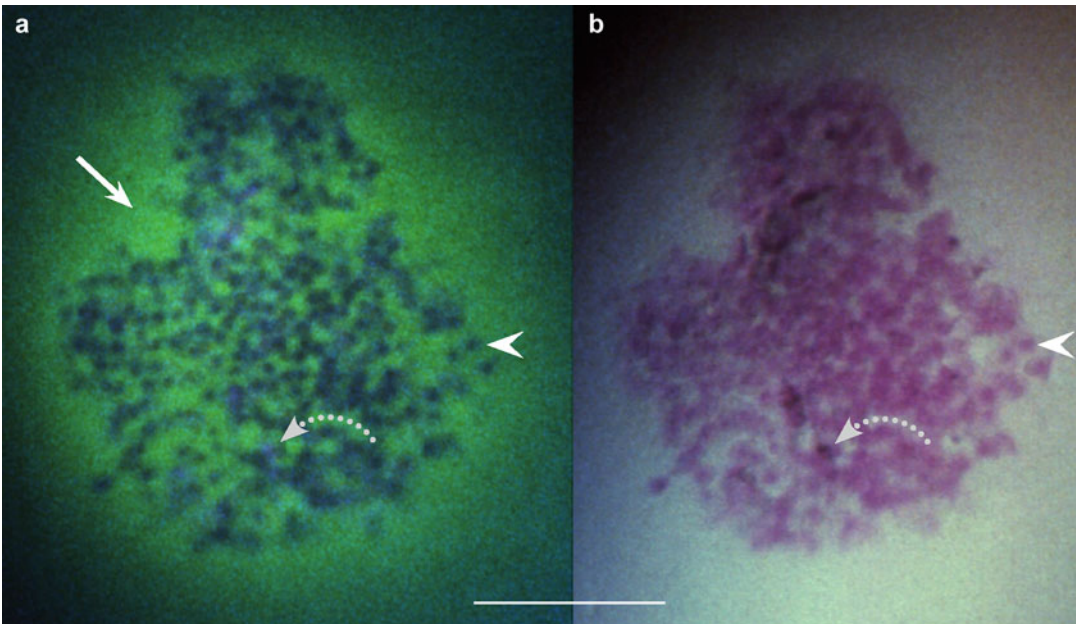


Fig. 2.46 A fleck showing (a) fluorescein diffusion into the tissues (green, *straight arrow*) and (a, b) small rose bengal stained nucleated cells (*arrowheads*) with

mucus adhering to some of them (*bowed arrows*). (The markers are placed in corresponding locations) (Adapted from [3])

Fluorescent Flecks (2, Additional Features) (cont.)

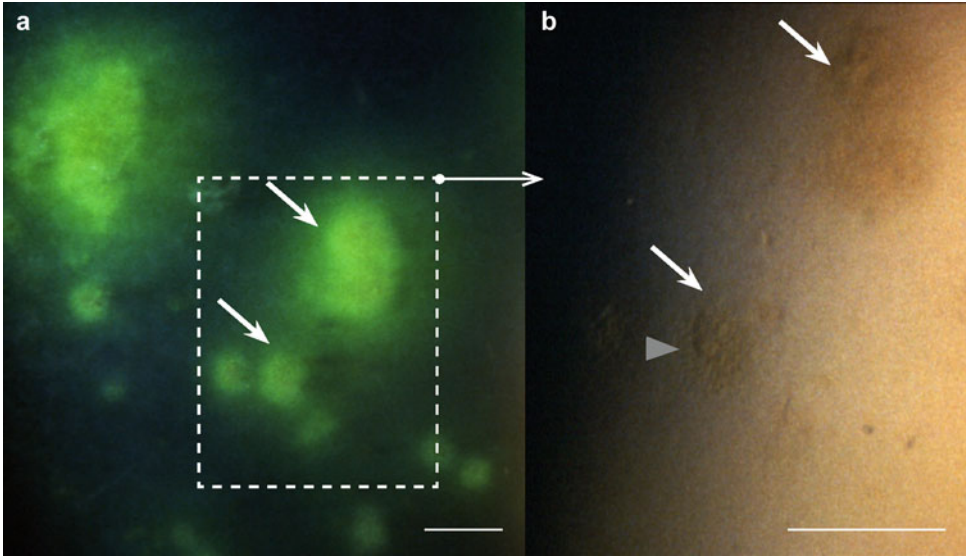
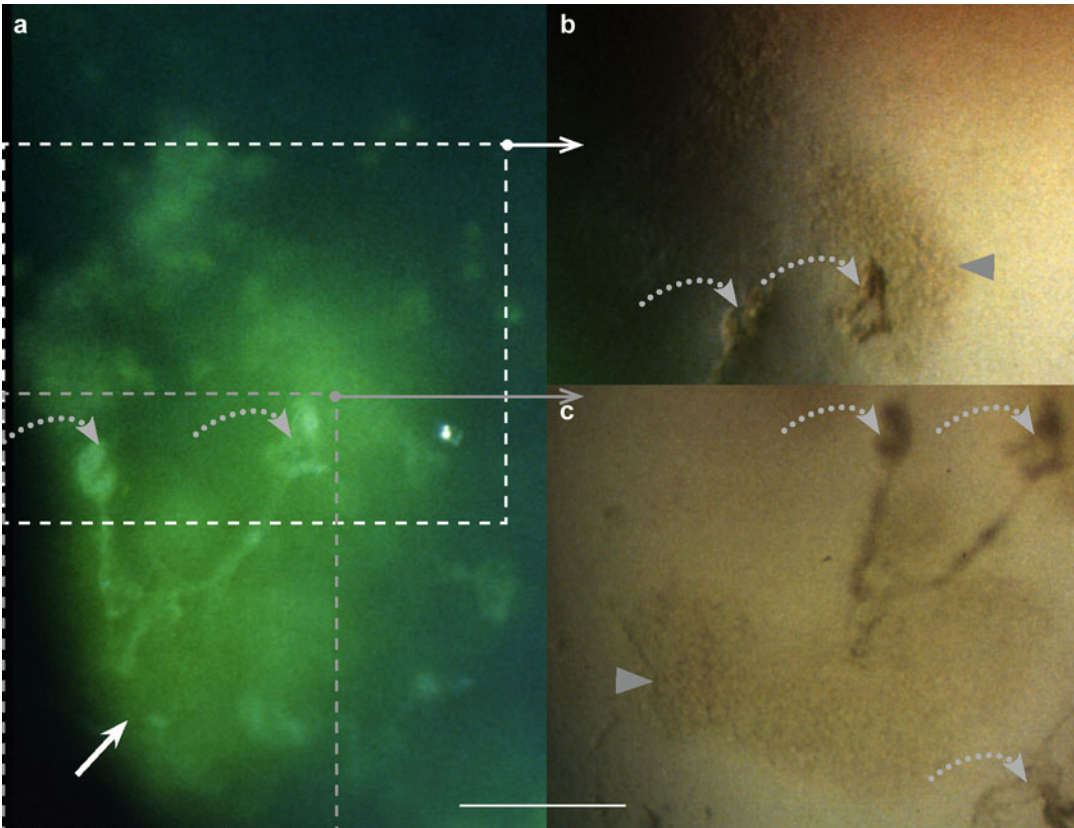


Fig. 2.47 (a) Survey capturing several larger and smaller green flecks (*arrows*) close to each other. The area in *frame* is shown in (b): the flecks appear darker

than their surroundings; the arrowhead indicates a spot in which is visible a fine granularity. (The arrows in **a** and **b** are placed in corresponding locations)



Fluorescent Flecks (2, Additional Features) (cont.)

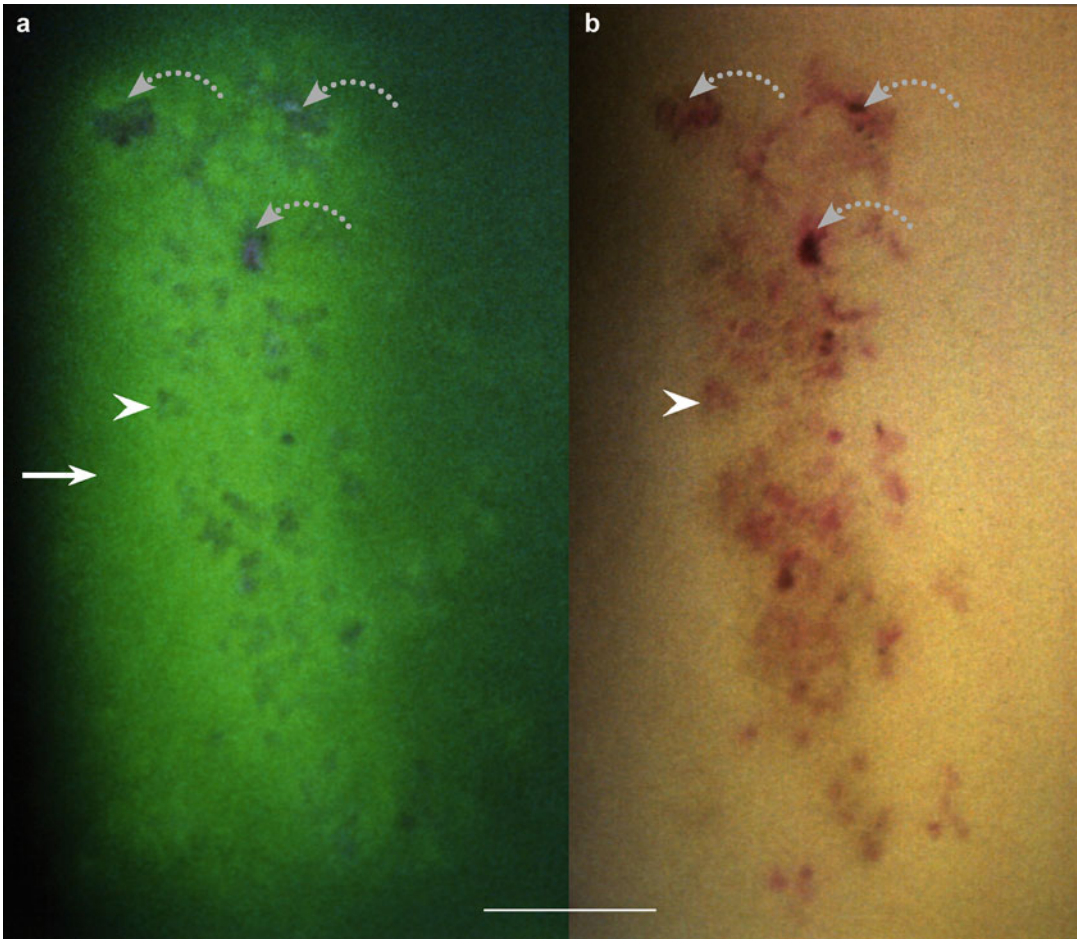


Fig. 2.49 The same cornea as in Fig. 2.47. A fleck showing surface-adherent mucus (*bowed arrows*), fluorescein diffusion into the tissues (green, *straight*

arrow in **a**) and rose bengal stained surface cells/cell fragments (*arrowheads*). (The markers are placed in corresponding locations)

Fig. 2.48 The same cornea as in Fig. 2.47. (**a**) A larger green fleck (*white arrow*) resulting from confluence of smaller ones. In the areas in *frames* is visible in (**b**) and (**c**) a fine granularity (*arrowheads*). The mucus (*bowed*

arrows) within the area of the fleck changes position but seems partly attached to the surface. An additional piece of mucus is visible in (**c**) (right lower corner, *bowed arrow*)

Adverse Effect of Rose Bengal (1)

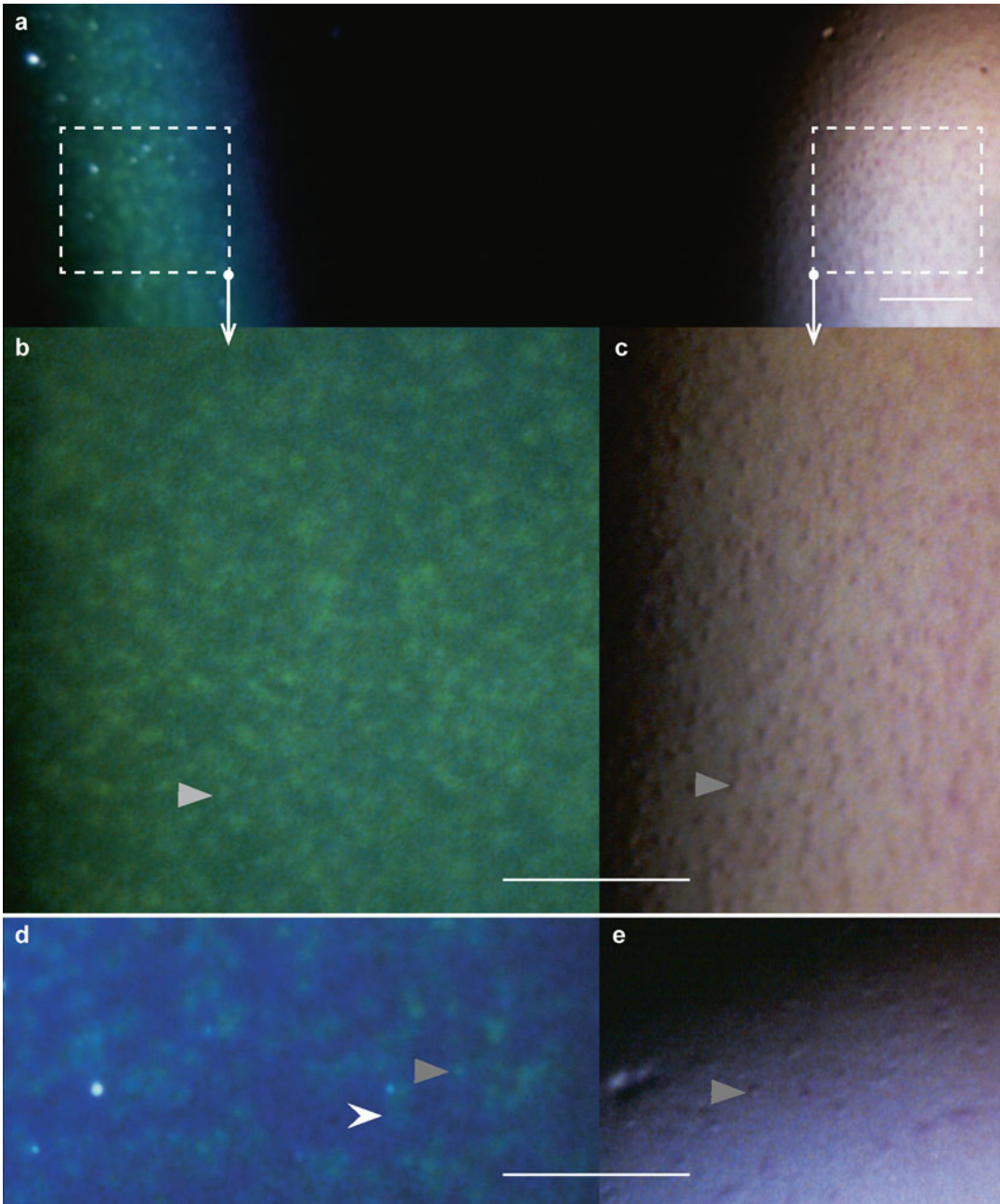


Fig. 2.50 Green corneal stipple in two corneae after the application of rose bengal in eyes preinstalled with fluorescein. Both corneae appeared normal before staining. (a) Survey. The areas in frames are shown at higher magnification in (b, c). (b) In the left part, many brightly green dots (*arrowhead*) are visible through the still green stained tear film. (c) In the right part are

visible many rounded bodies (*arrowhead*). (d, e) show another cornea. (d) Fluorescein has disappeared from the tear film; visible are bright dots (*grey arrowhead*) and larger green dots (*white arrowhead*) that probably represent surface cells (cf. Fig. 2.51). (e) Also here are visible many rounded bodies (*arrowhead*)

Adverse Effect of Rose Bengal (2)

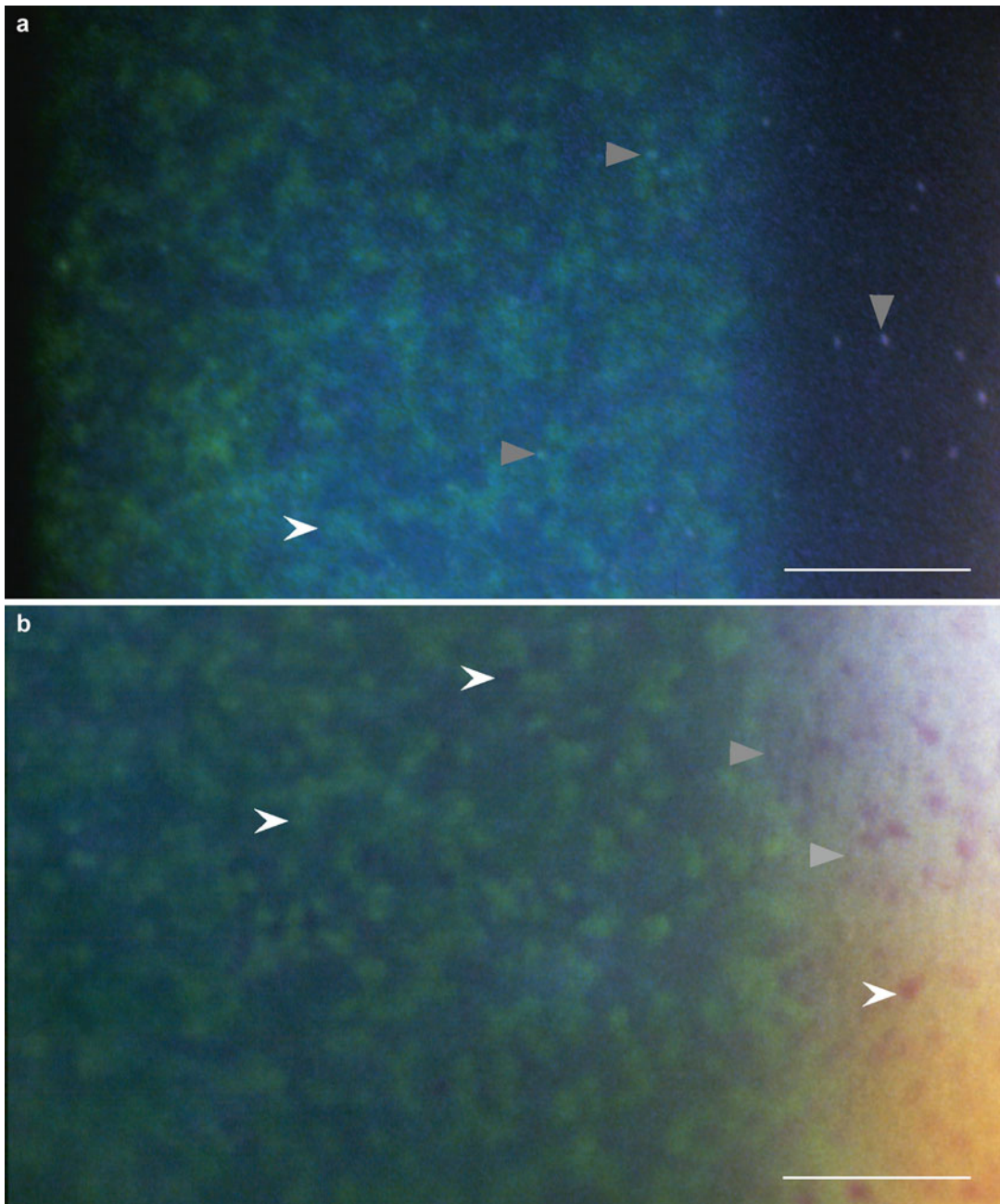


Fig. 2.51 Green corneal stipple in two corneae after the application of rose bengal in eyes preinstalled with fluorescein. Before staining both corneae appeared normal. (a) In the left part of the picture are visible myriads of bright dots, some small and rounded (*grey arrowheads*), others as larger green dots (*white arrowhead*) probably representing surface cells. In the right part are visible rounded bodies (*grey arrowhead*). (b)

Also in this cornea appeared myriads of green dots after the application of rose bengal. The *white arrowheads* indicate green (left) and red (right) stained dots compatible with surface cells. Rounded bodies are only faintly visible (*grey arrowheads*) (If observed after the fluorescein had disappeared from the tear film, this cornea might have shown a fine punctate fluorescein staining before the application of rose bengal)

Mechanical Surface Damage

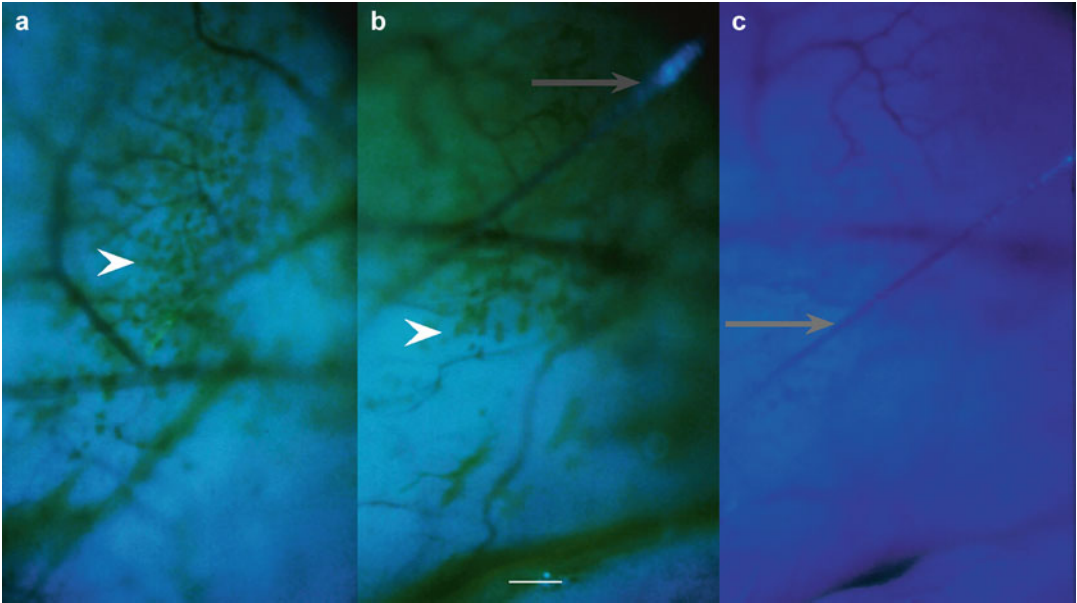


Fig. 2.52 (a–c) Damaged surface cells staining with non-fluorescent fluorescein (*arrowheads*) in trichiasis. An offending eyelash is indicated by *arrow*. (Conjunctival surface; **a, b** green filter, **c** blue filter)

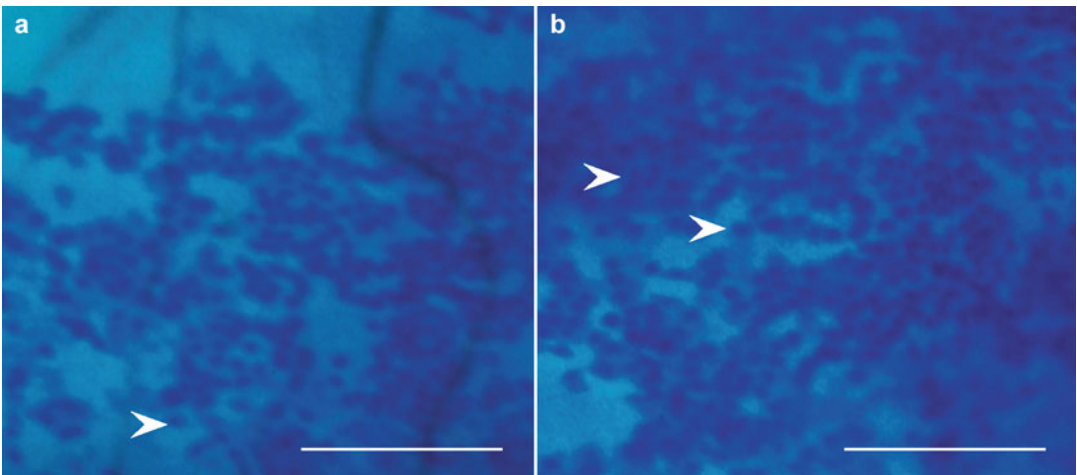


Fig. 2.53 (a, b) Surface damage caused by contact with paper strip used in Schirmer test; visible are many small rose bengal stained cells (*arrowheads*). (Conjunctival surface, green filter)

Addendum

An additional example of mechanical surface damage is shown in Fig. 4.31.

Fluorescent Flecks Versus HSV. Surface-Adherent Mucus Versus HZO Mucus Plaques

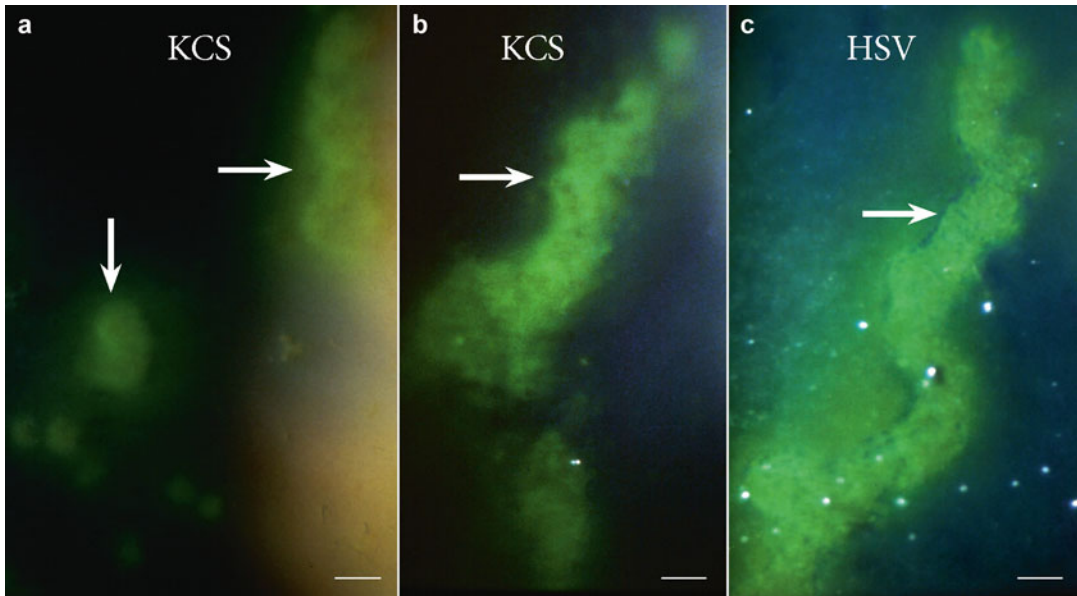


Fig. 2.54 (a, b) Green flecks (*arrows*) in KCS, individual and confluent; the figures with undulating borders remind of (c) herpes simplex virus lesions (HSV) (a Adapted from [3]; c Adapted from [11])

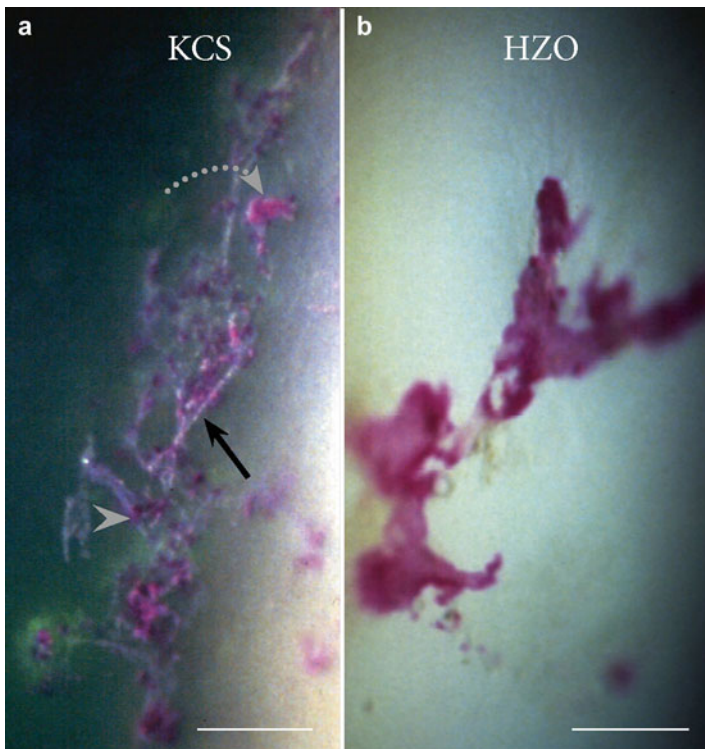


Fig. 2.55 (a) In KCS, mucus adhering to the surface shows threads (*straight arrow*) and patches (*bowd arrow*); the figure contains also cell debris (*arrow-head*). (b) For comparison, a typical red stained mucus plaque in herpes zoster ophthalmicus (HZO) (Adapted from [5, 12])

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