

The normal cervix: cytology, colposcopy, and histology

Alan G. Waxman, MD, MPH
University of New Mexico School of Medicine
Department of Obstetrics and Gynecology
Albuquerque, New Mexico



*Improving Lives Through the Prevention & Treatment
of Anogenital & HPV-Related Diseases*

Courses
Comprehensive Colposcopy

Disclosures

- Alan G. Waxman, MD, MPH – Faculty – No Disclosures
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Images used with permission:

- Apgar B, Brotzman G, Spitzer M. Integrated Colposcopy: A Text and Atlas. Elsevier; 2002, 2008. (ABS)
- Ferris D, Cox T, O'Connor D, Wright C. Modern Colposcopy. Wolters Kluwer, ASCCP; 2002
- Personal collections as noted on slides



Improving Lives Through the Prevention & Treatment
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————— Courses —————
Comprehensive Colposcopy

Objectives

- Review the epithelial features of the normal transformation zone
- Discuss the process of squamous metaplasia
- Explain the normal features of the transformation zone according to age
- Describe features that define a satisfactory colposcopy

Origin of cervical epithelium

- Vagina is originally lined by columnar epithelium derived from fusion of the *Mullerian ducts*
 - Lines the endocervix and is continuous with the endometrium
- Gradually replaced by a core of stratified squamous epithelium originating in the *urogenital sinus*
 - Lines the vagina, portio vaginalis of the cervix
- Rudimentary cervix by 16 weeks gestation

Types of cervical epithelia

Stratified squamous

- Covers the ectocervix and vagina
- Multilayered epithelium, rests on basement membrane
- ****Smooth pink color*

Tall columnar

- Lines the endocervix
- One cell layer thick, mucin-secreting, numerous folds
- ****Bright red irregular color*

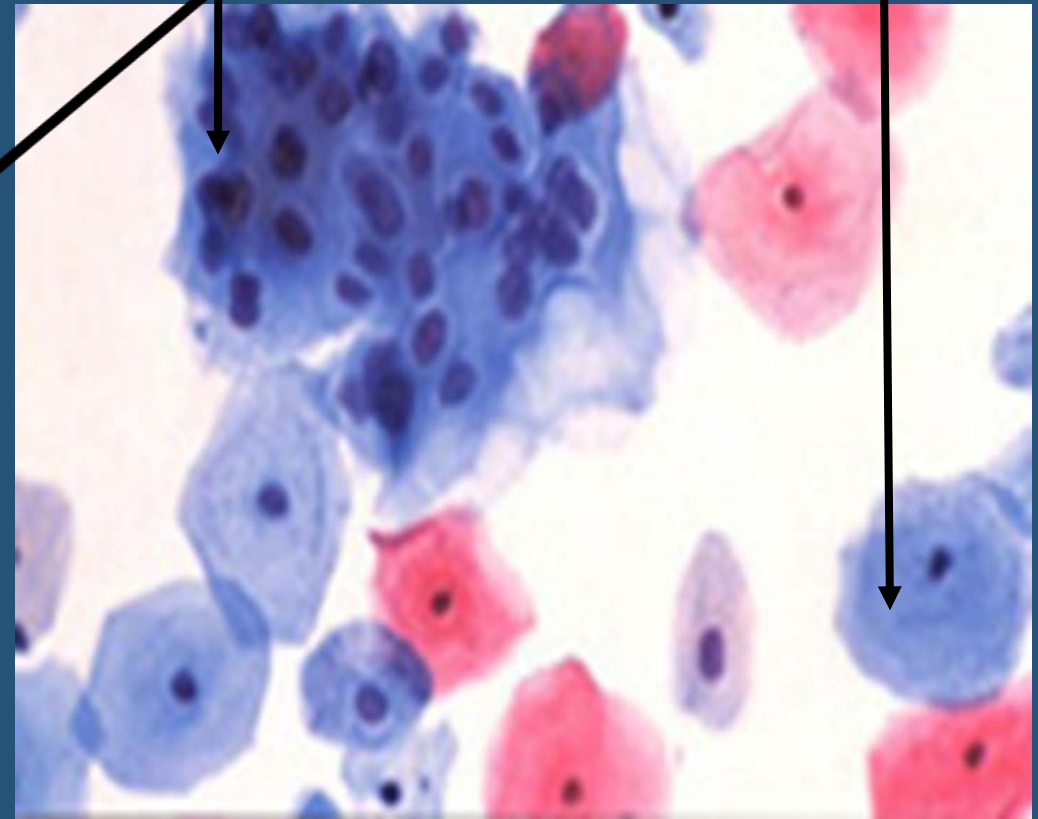
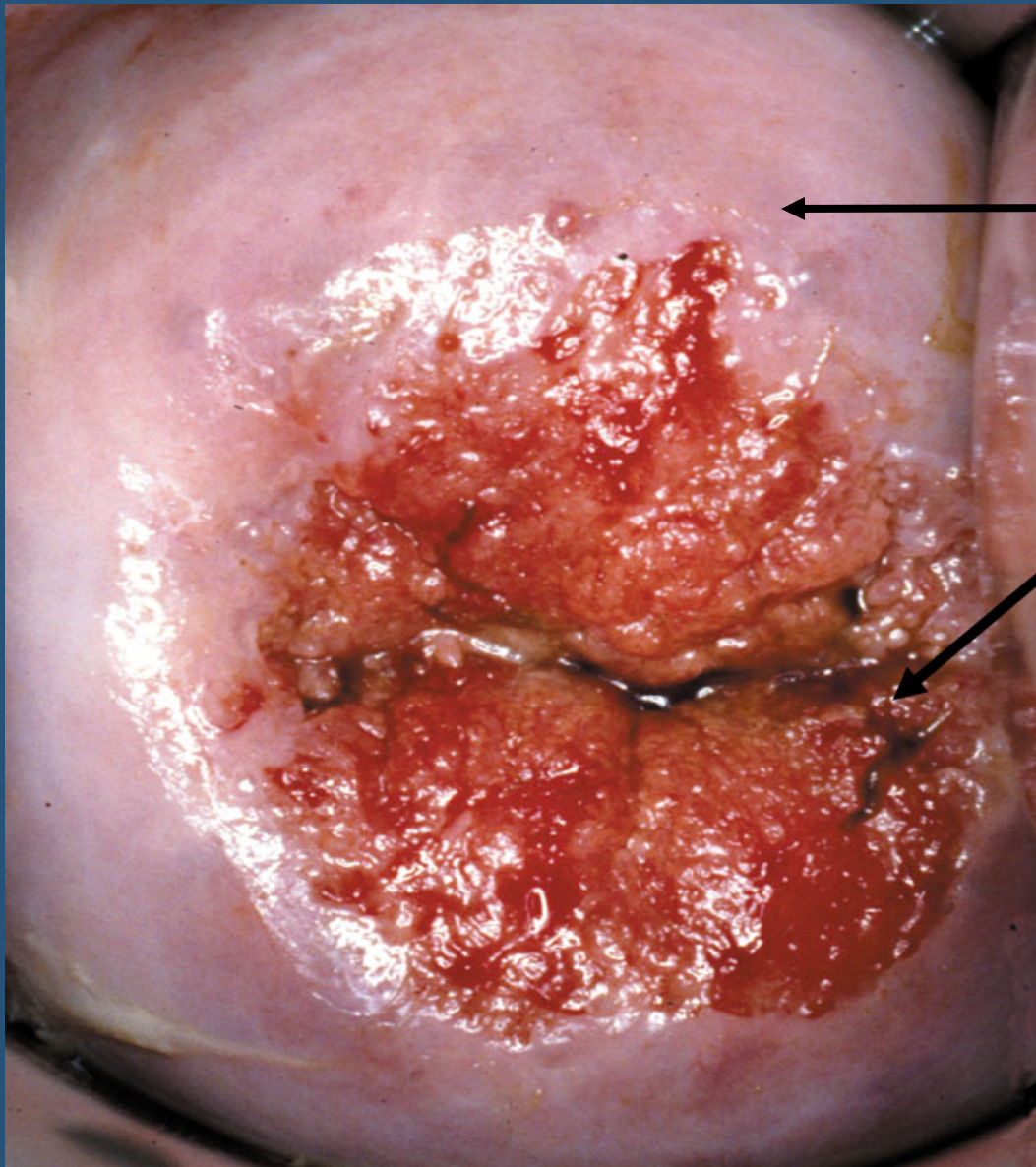
Metaplasia: immature and mature

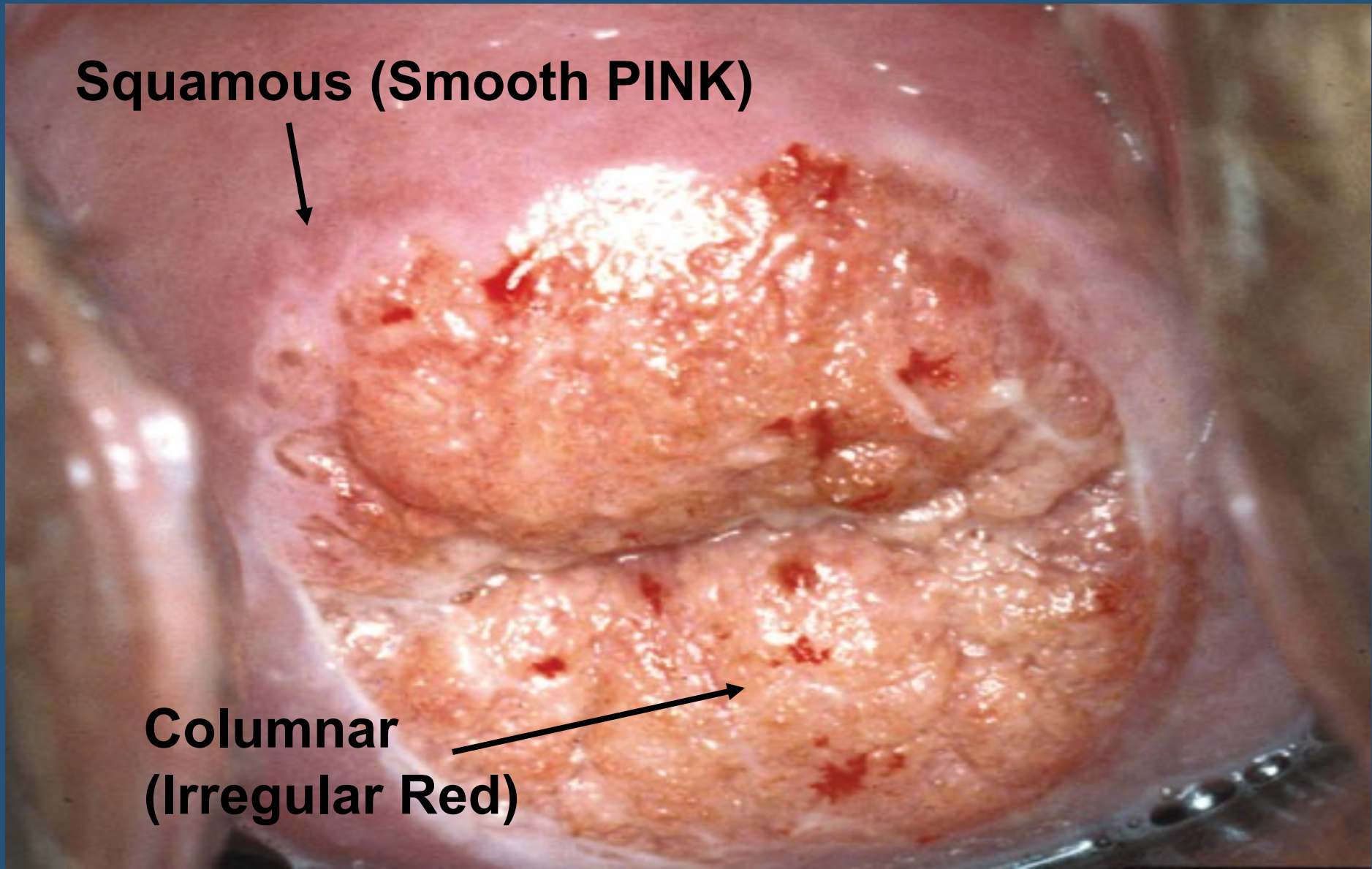
- Lies between columnar and squamous epithelium
- ****Faint acetowhite color after vinegar application*

2 types of epithelium

Squamous

Columnar





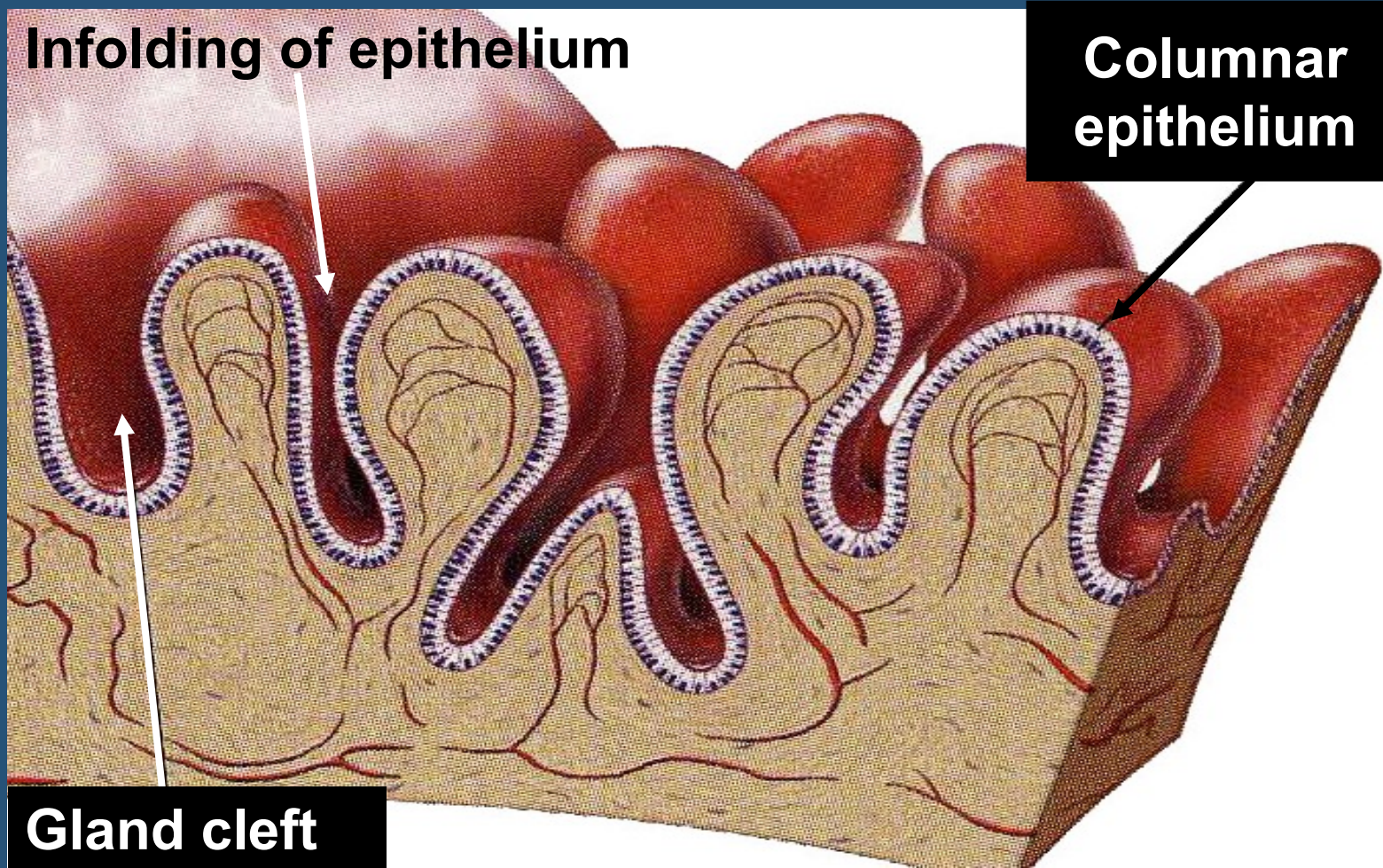
Squamous (Smooth PINK)



**Columnar
(Irregular Red)**



Columnar epithelium



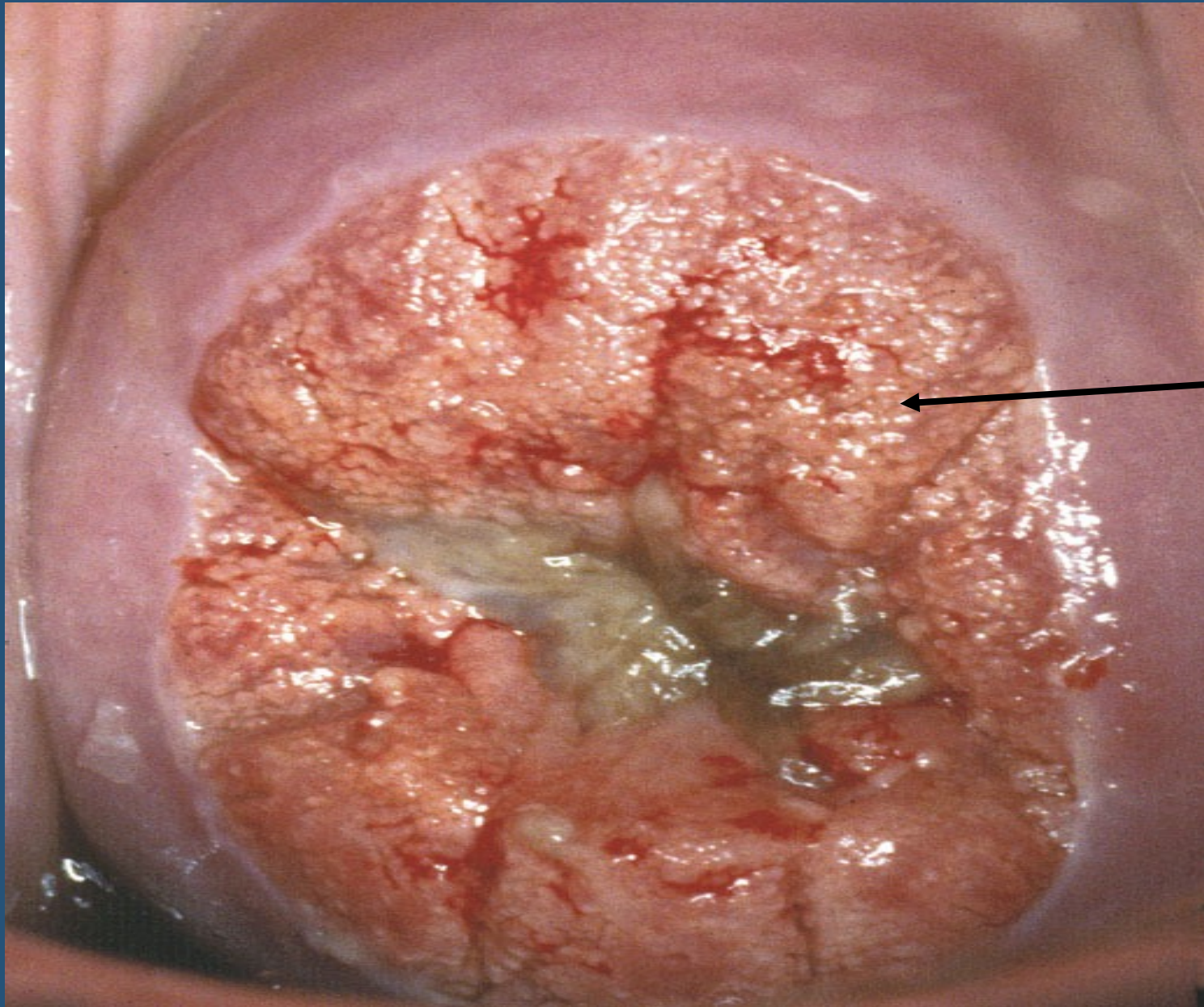
Columnar epithelium

- Single layer tall columnar cells lining endocervical canal
 - Course proximally from SCJ through endocervical canal to internal os
 - Majority secrete mucus; may have cilia
- Covers villi that contain central loop capillaries
 - ***Vessels are poorly concealed: epithelium is “red” compared to squamous “pink”
- Endocervical cells invaginate into the stroma to depth of 5-8mm
 - Are called “glands” but are technically crypts
 - Infolding of epithelium creates texture on surface

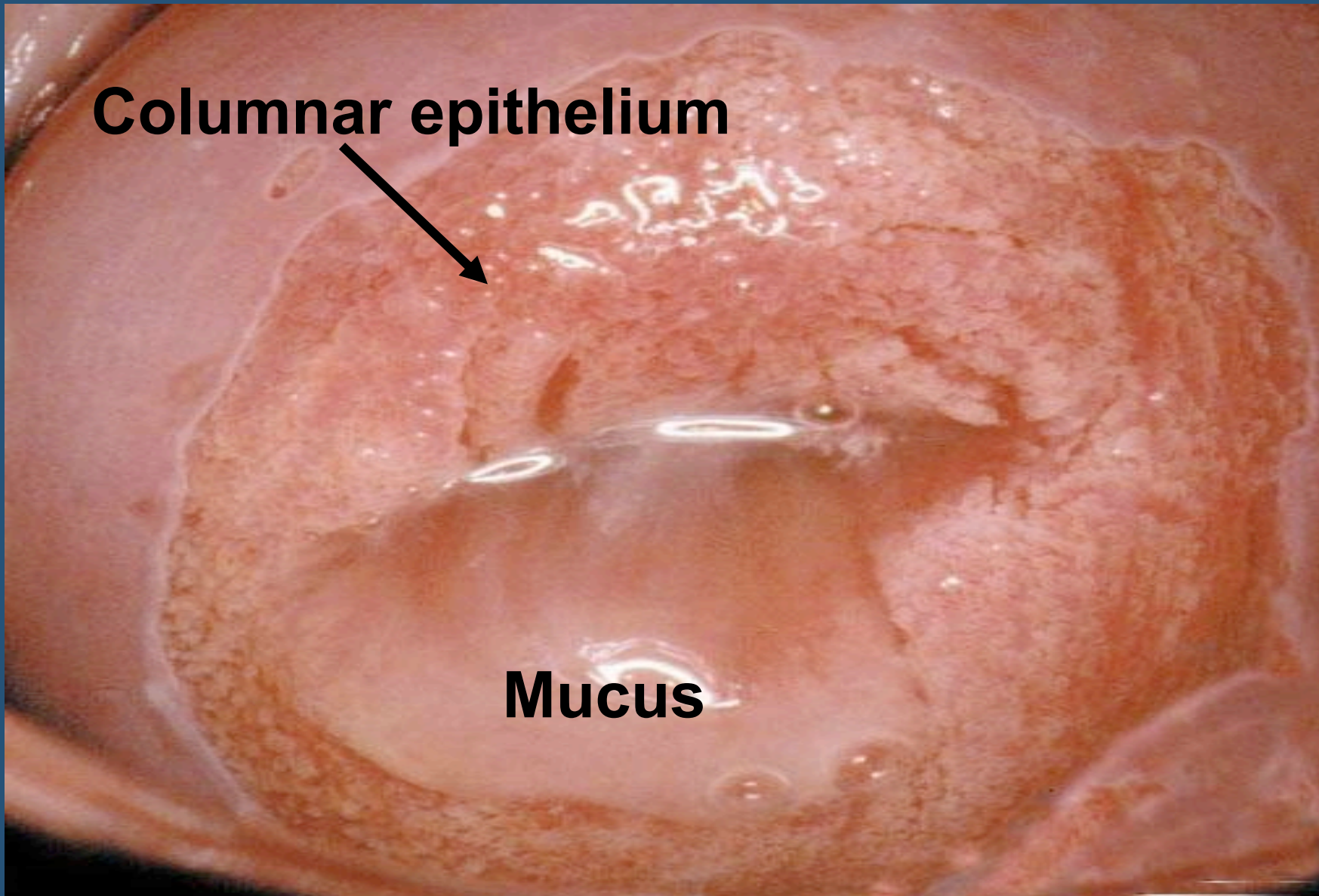
Columnar epithelium



Stroma with blood vessels



**Columnar
epithelium**
****redder****
than squamous



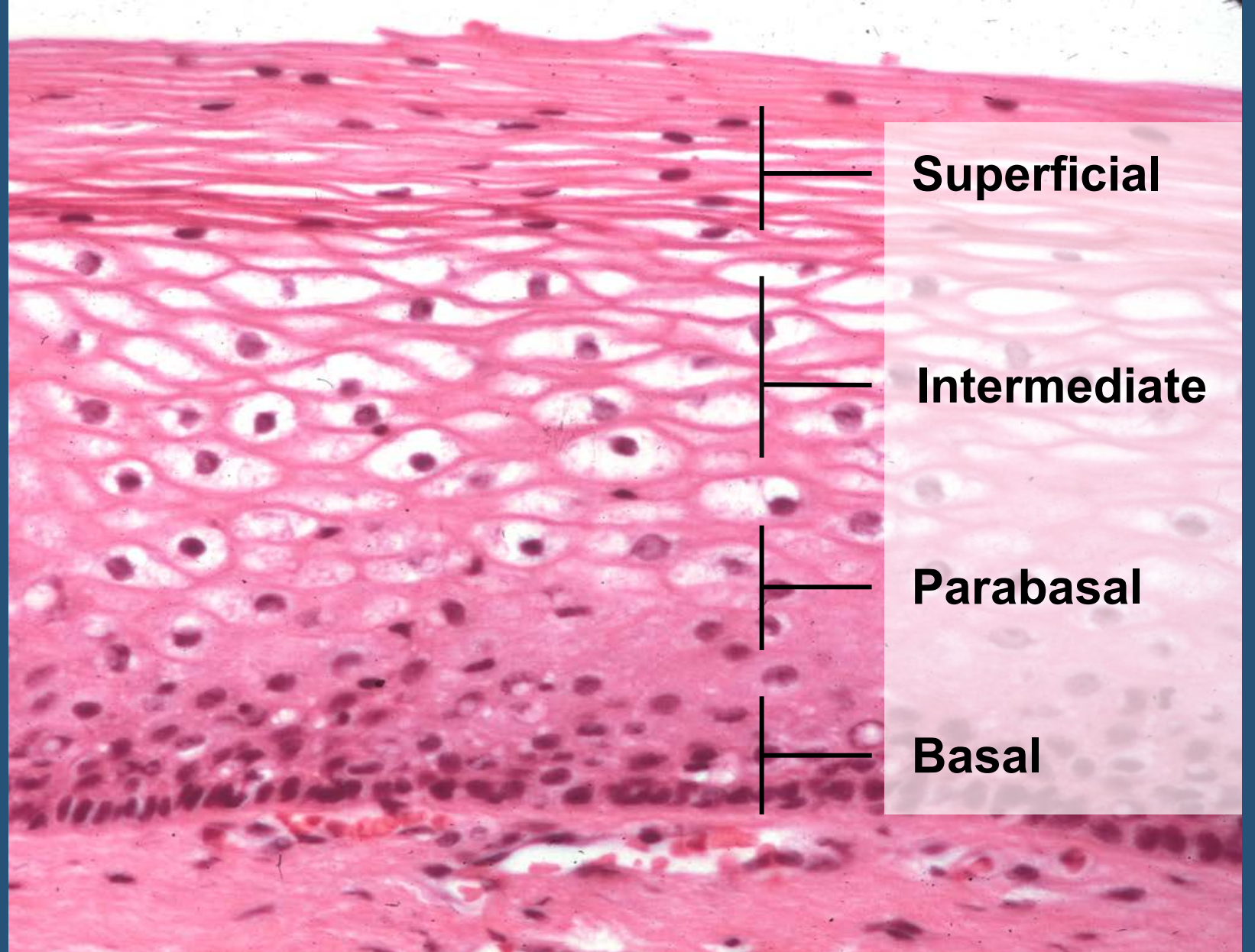
Columnar epithelium



Mucus

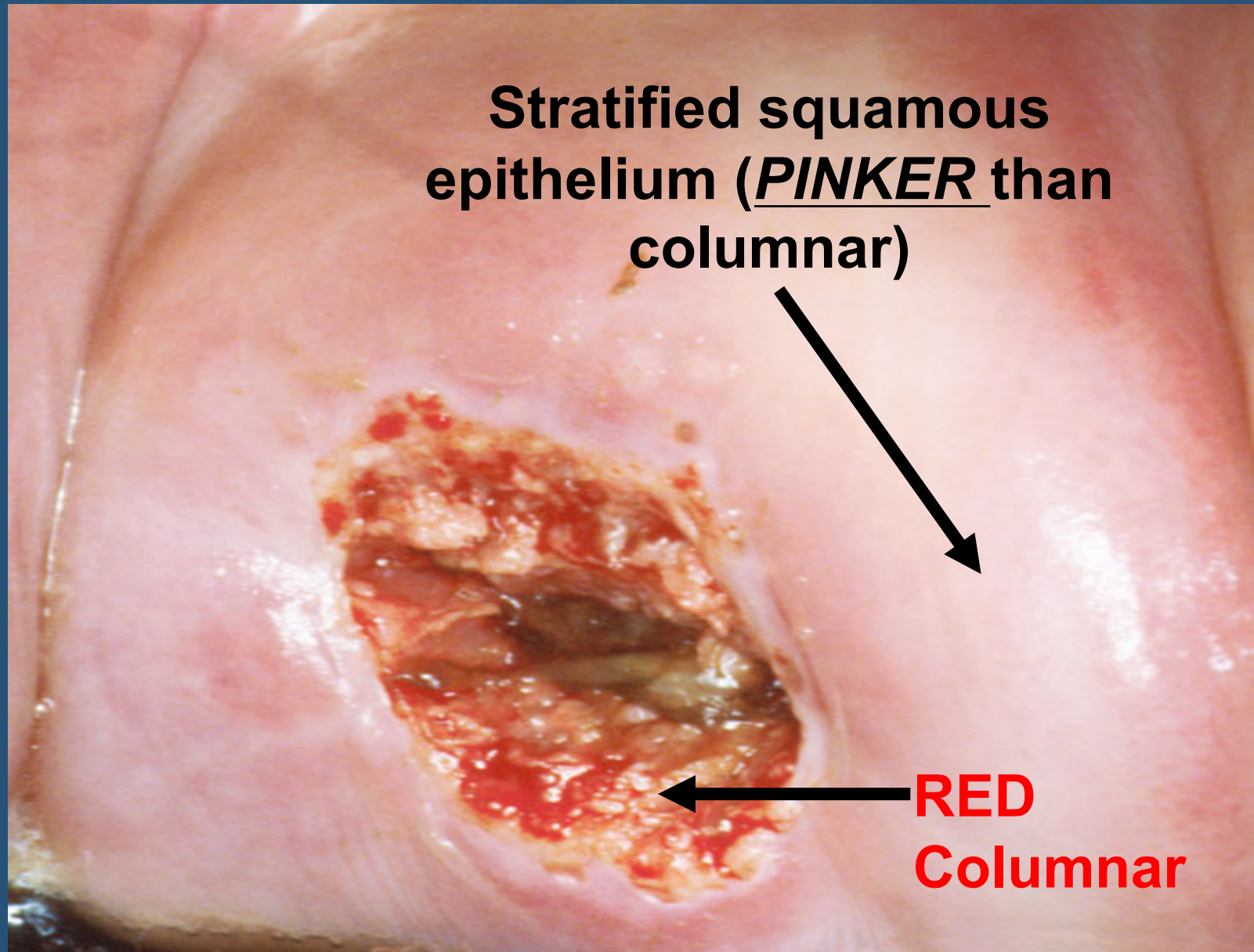
**18-year-old
adolescent**

**Stratified
squamous
epithelium
divided
into 4 layers**



Stratified squamous epithelium

- Estrogen continuously remodels squamous epithelium in premenopausal women
 - Epithelial proliferation
 - Epithelial maturation
 - Epithelial desquamation
- Divided into layers
 - Basal / parabasal / intermediate / superficial
 - Regeneration from the basal layer under influence of estrogen

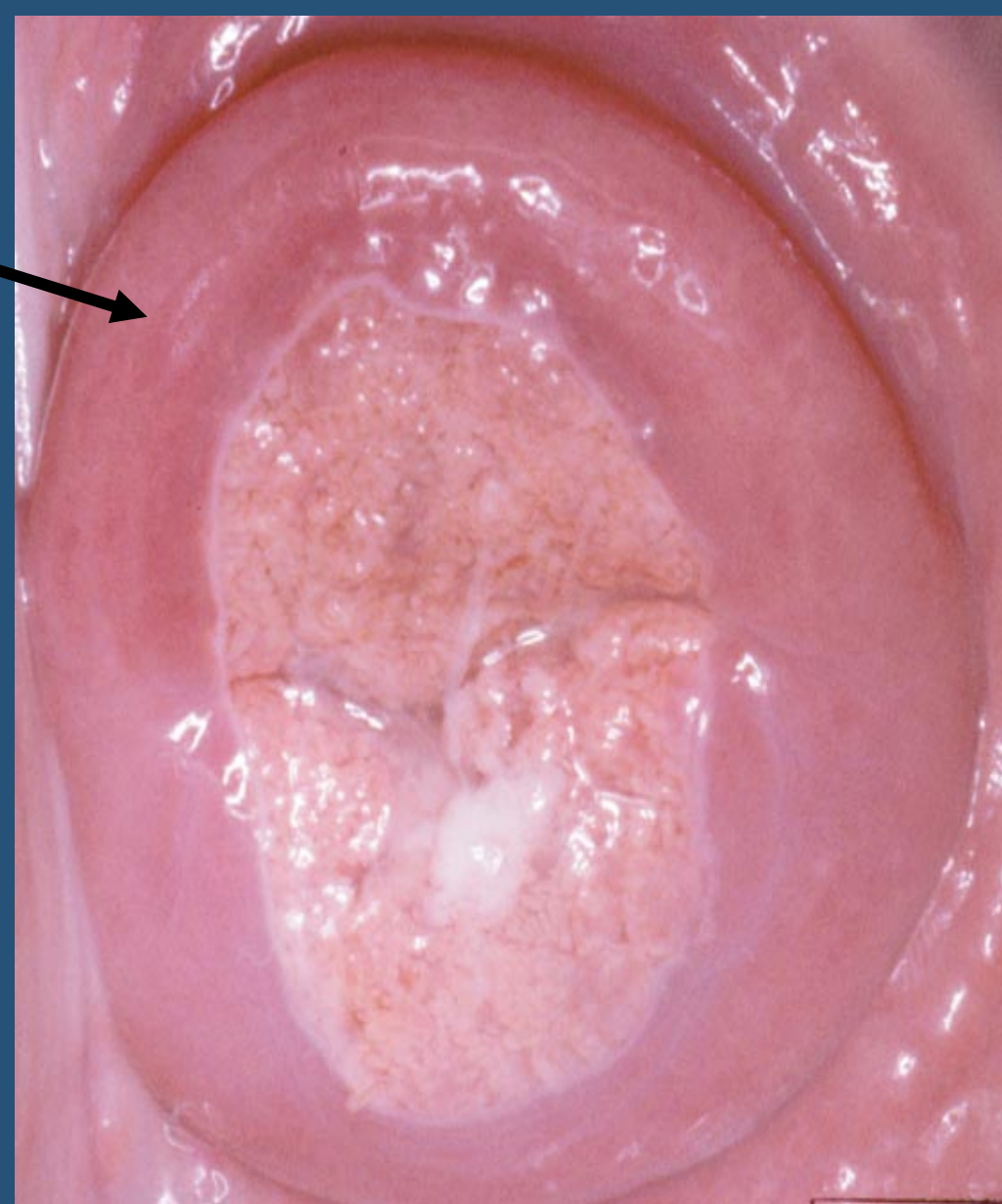
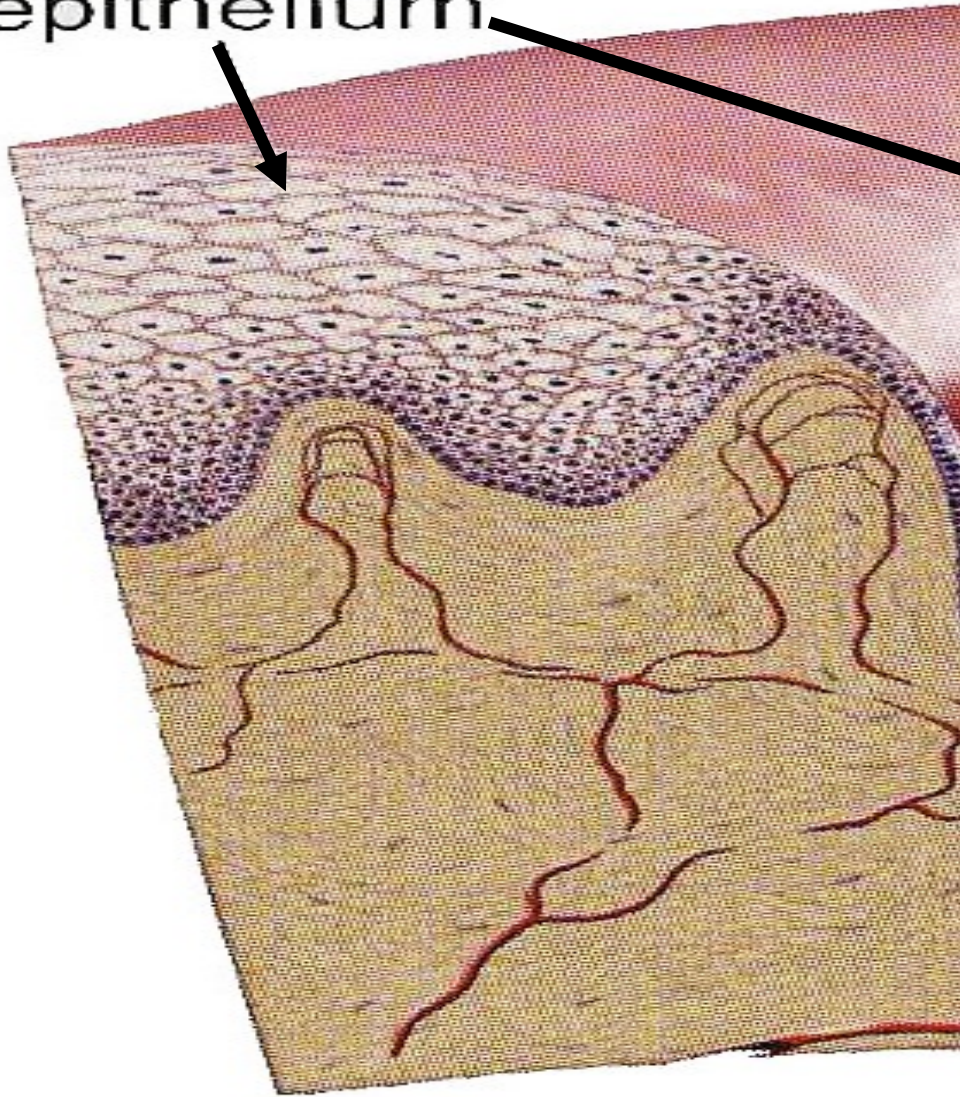


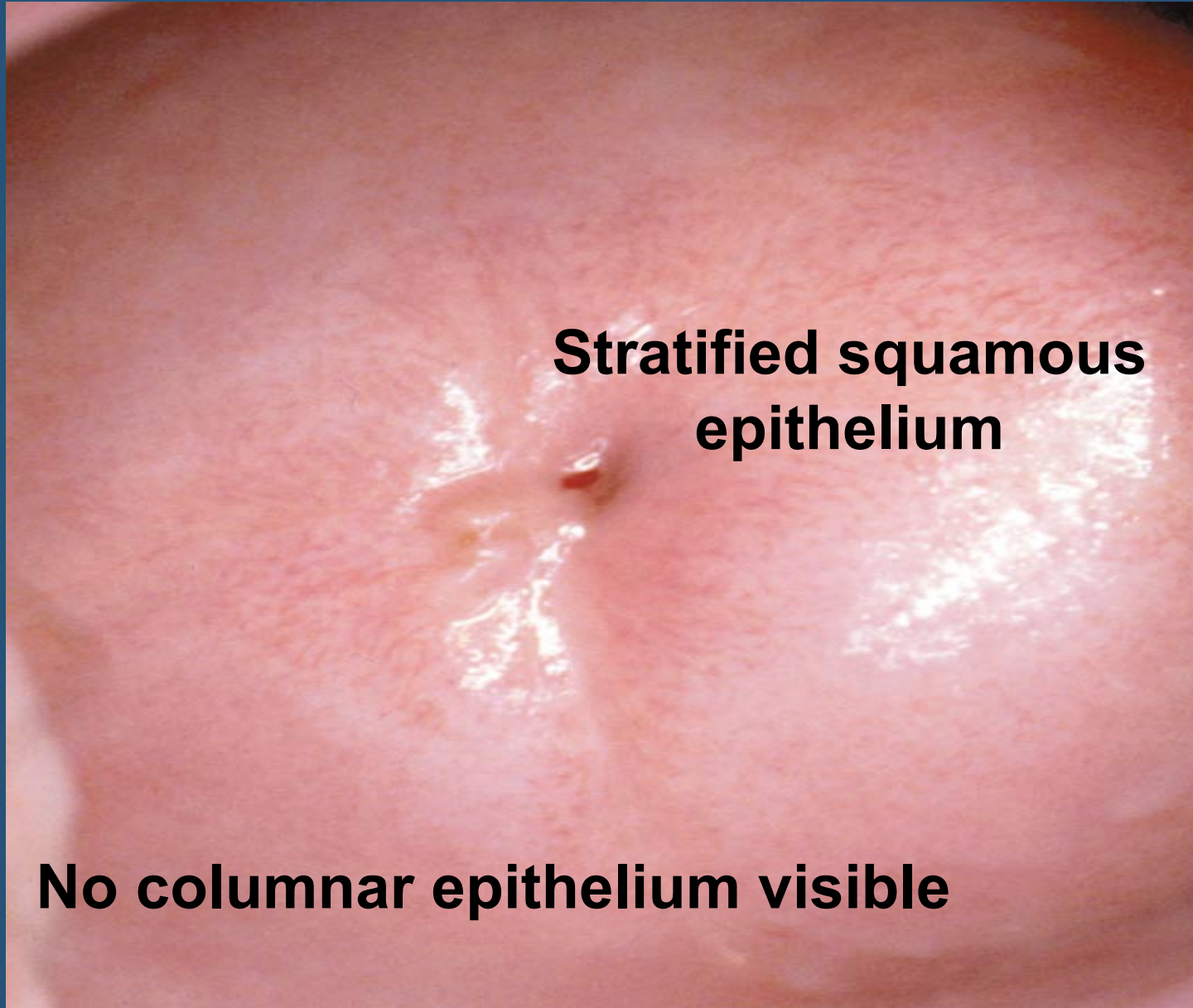
Stratified squamous
epithelium (PINKER than
columnar)

30-year-old
Individual

RED
Columnar

squamous
epithelium





**Stratified squamous
epithelium**

No columnar epithelium visible

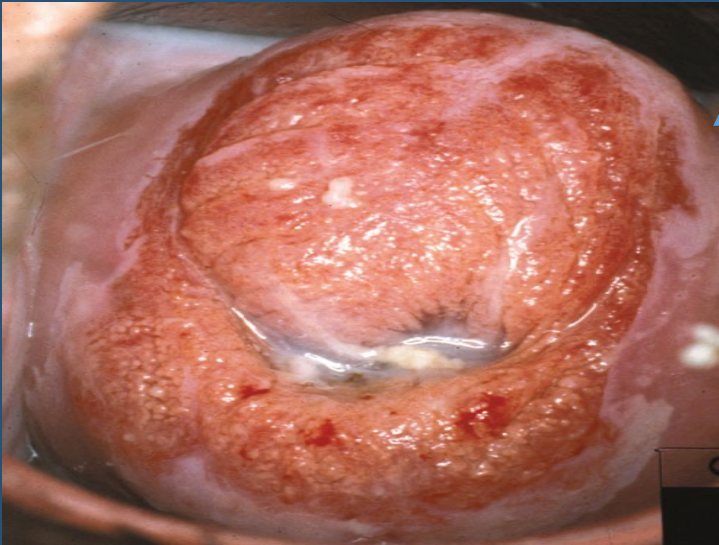
**65-year-old
postmenopausal
individual**

Squamocolumnar junction (SCJ)

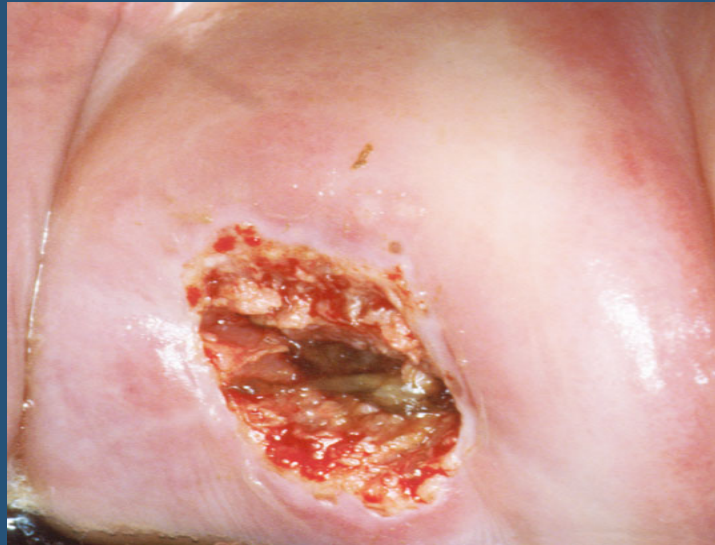
Interface between the columnar epithelium and squamous epithelium

- Original SCJ is defined at birth
 - Separates the original glycogenated squamous epithelium from the original columnar epithelium
 - Embryologically determined caudal extent of columnar epithelium
 - Cervical “transformation” begins here

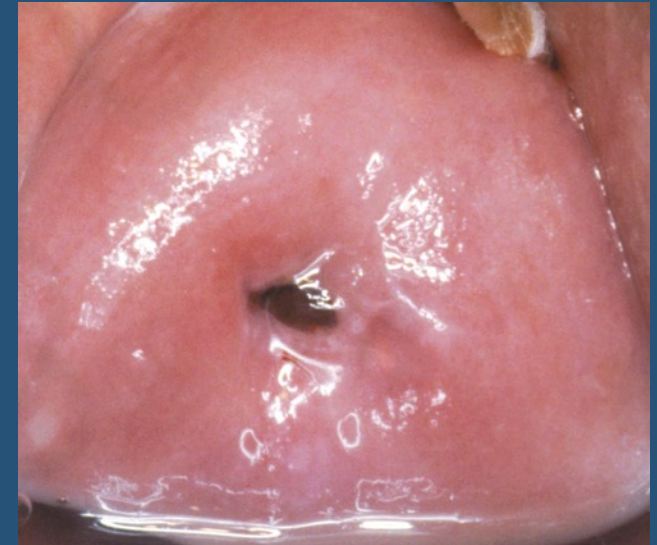
Life cycle of the SCJ



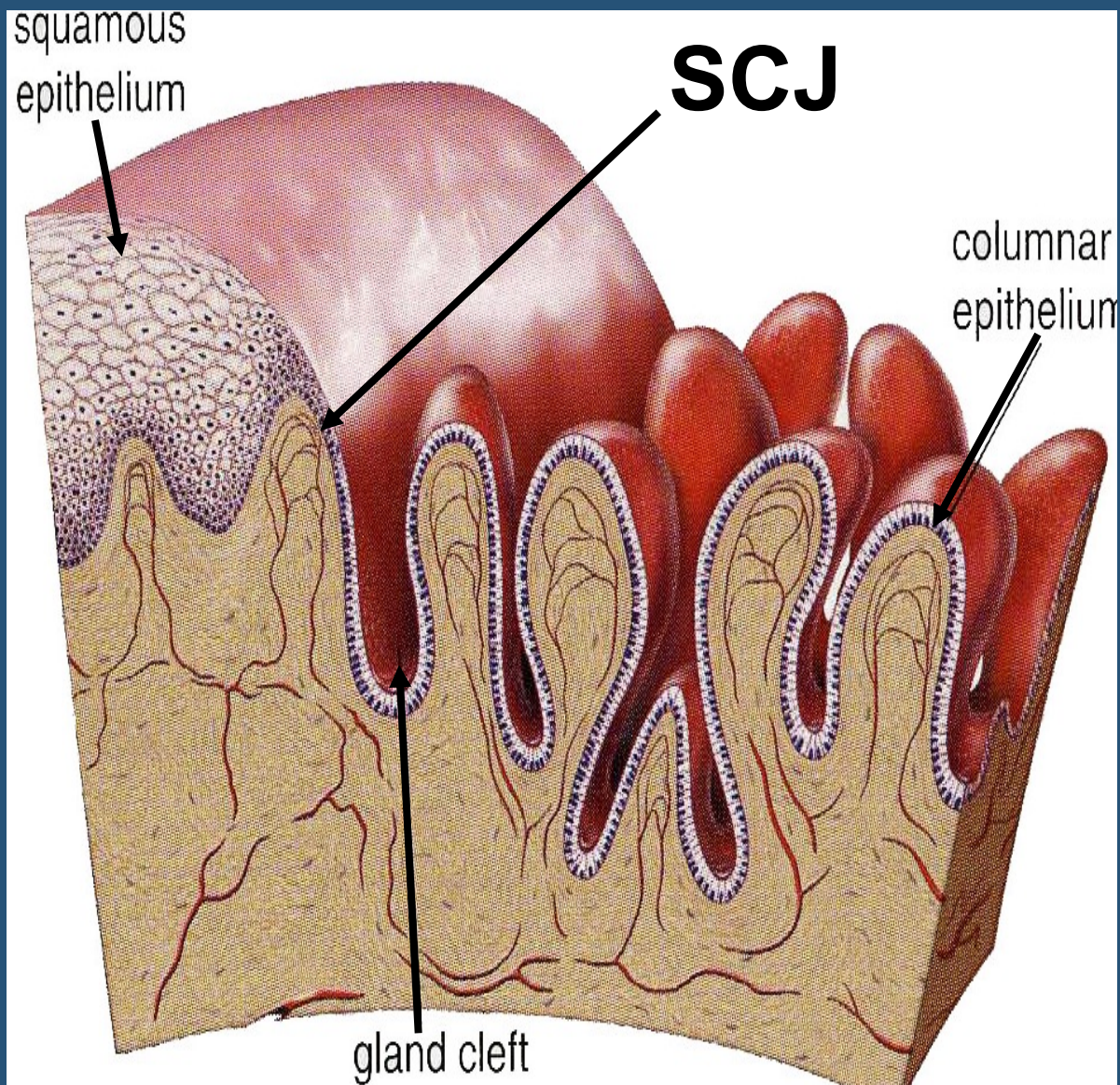
Adolescence



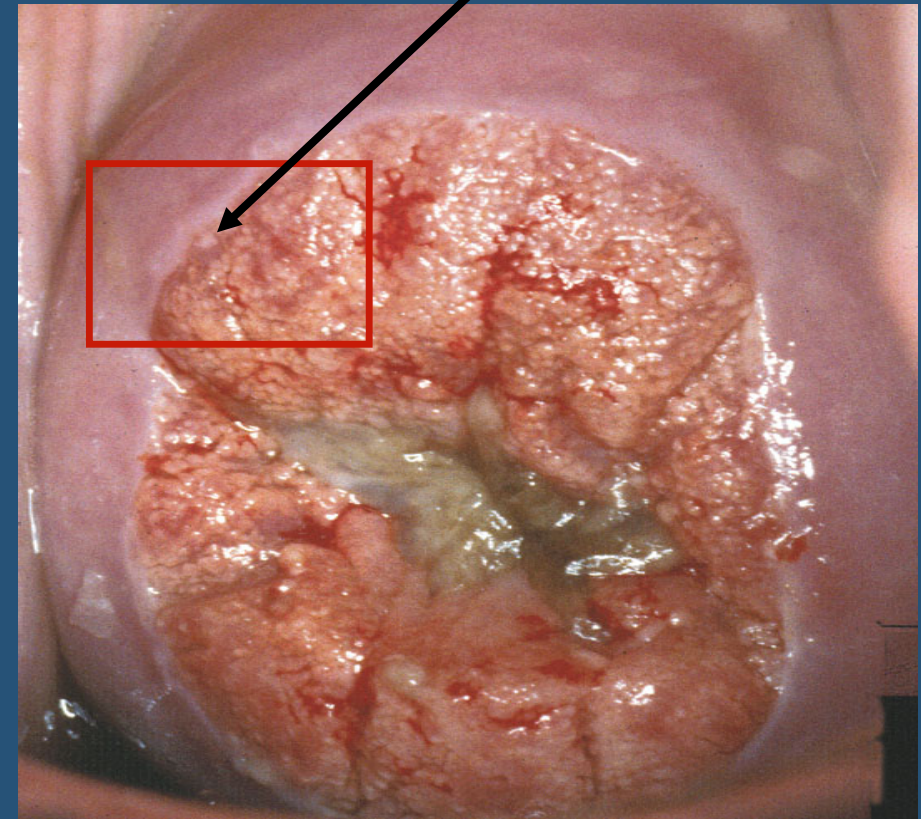
Reproductive years



Postmenopause

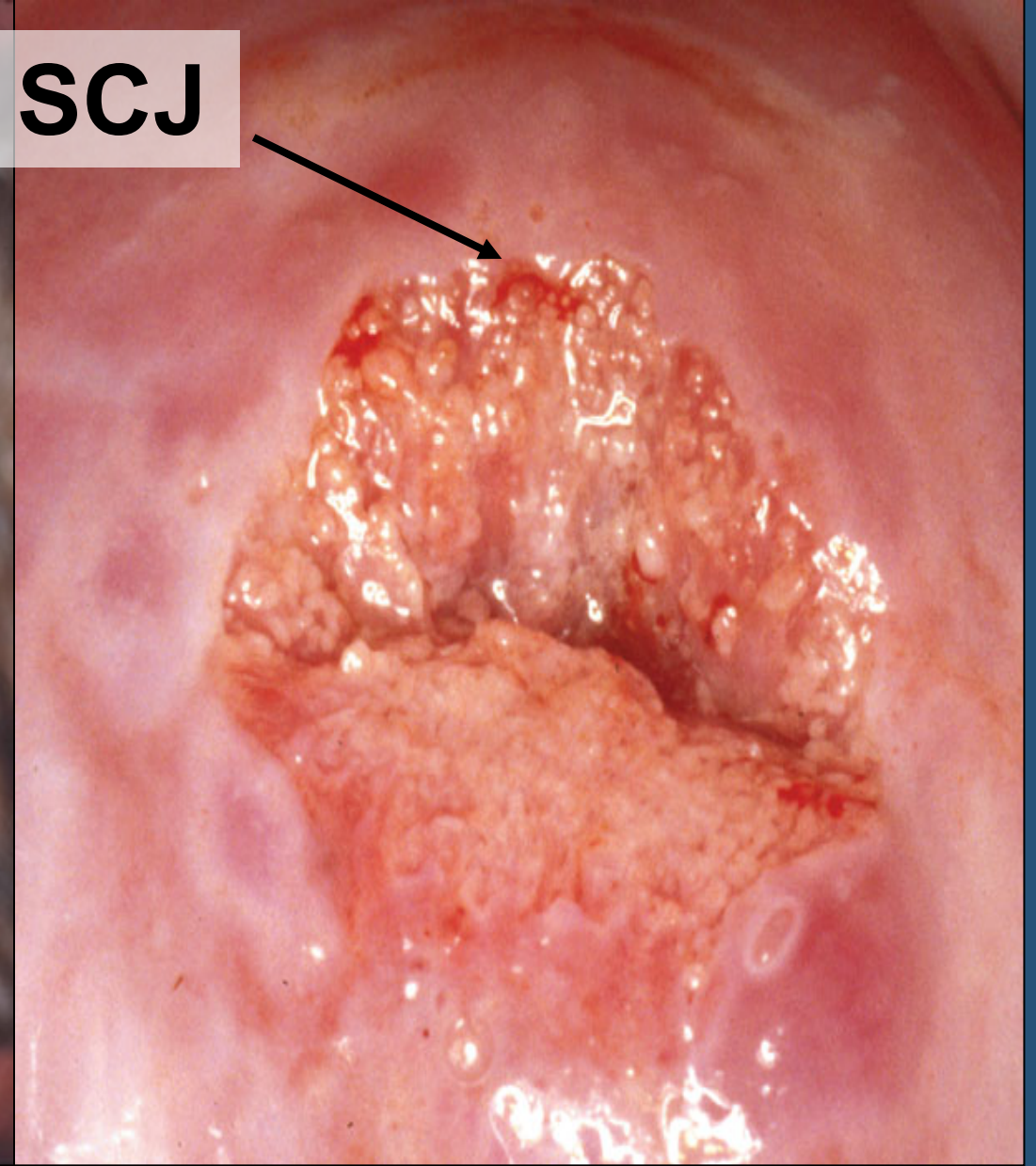
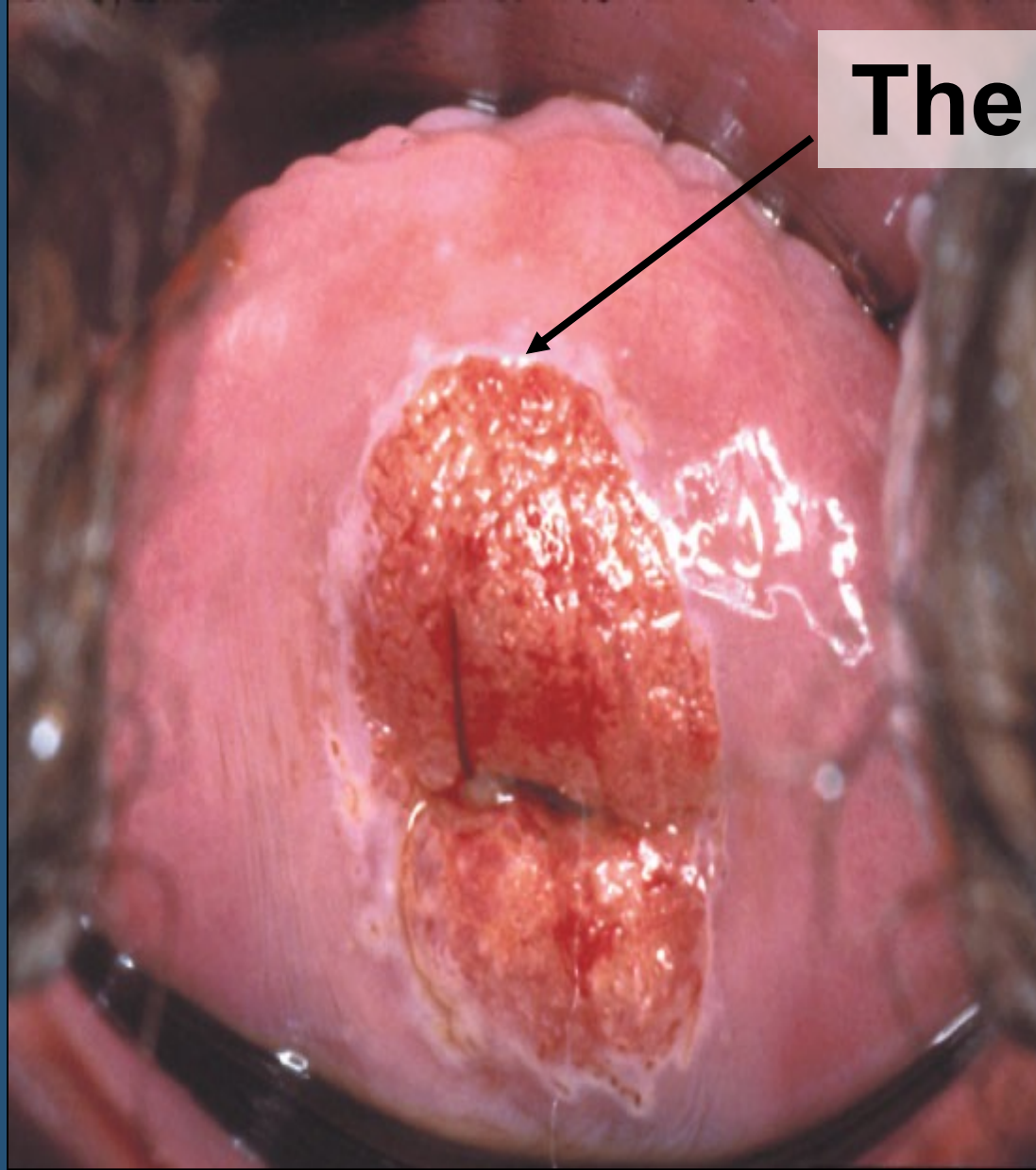


The SCJ

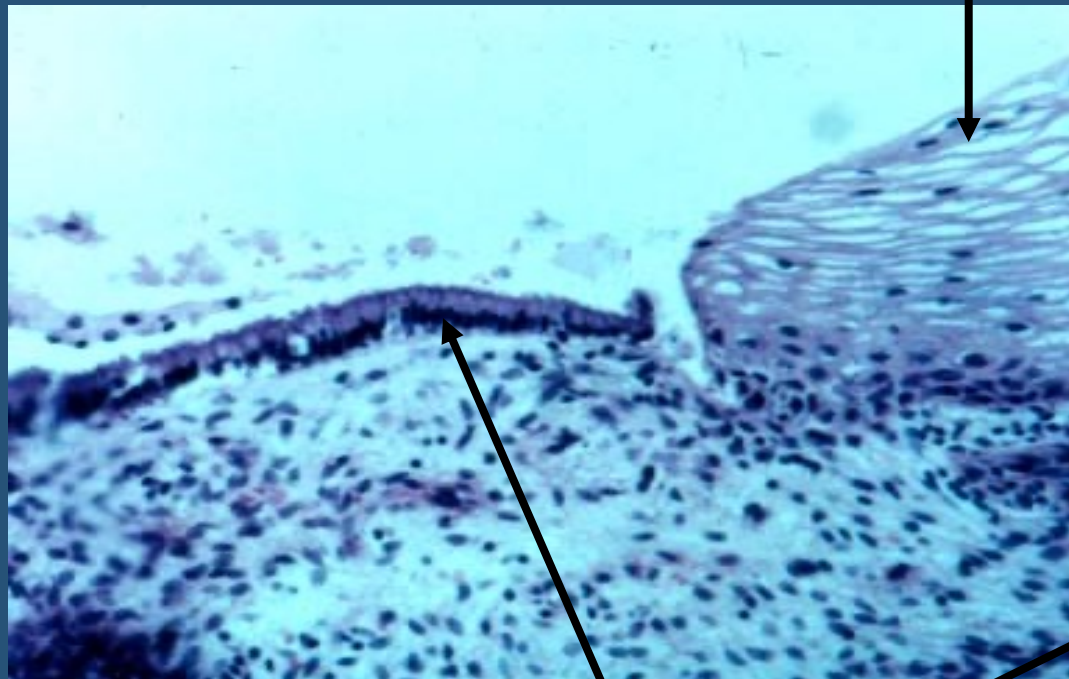


Mayeaux, E. J., & Cox, J. T. (2012). *Modern colposcopy: textbook & atlas*. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins.

The SCJ

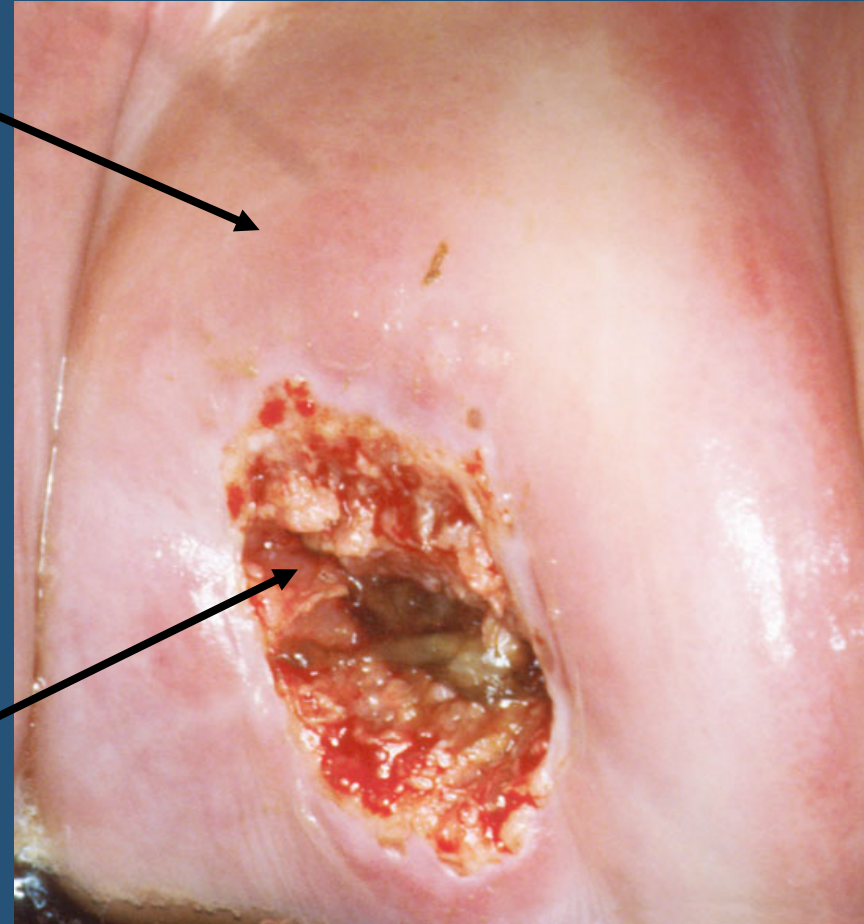


The evolution of the SCJ



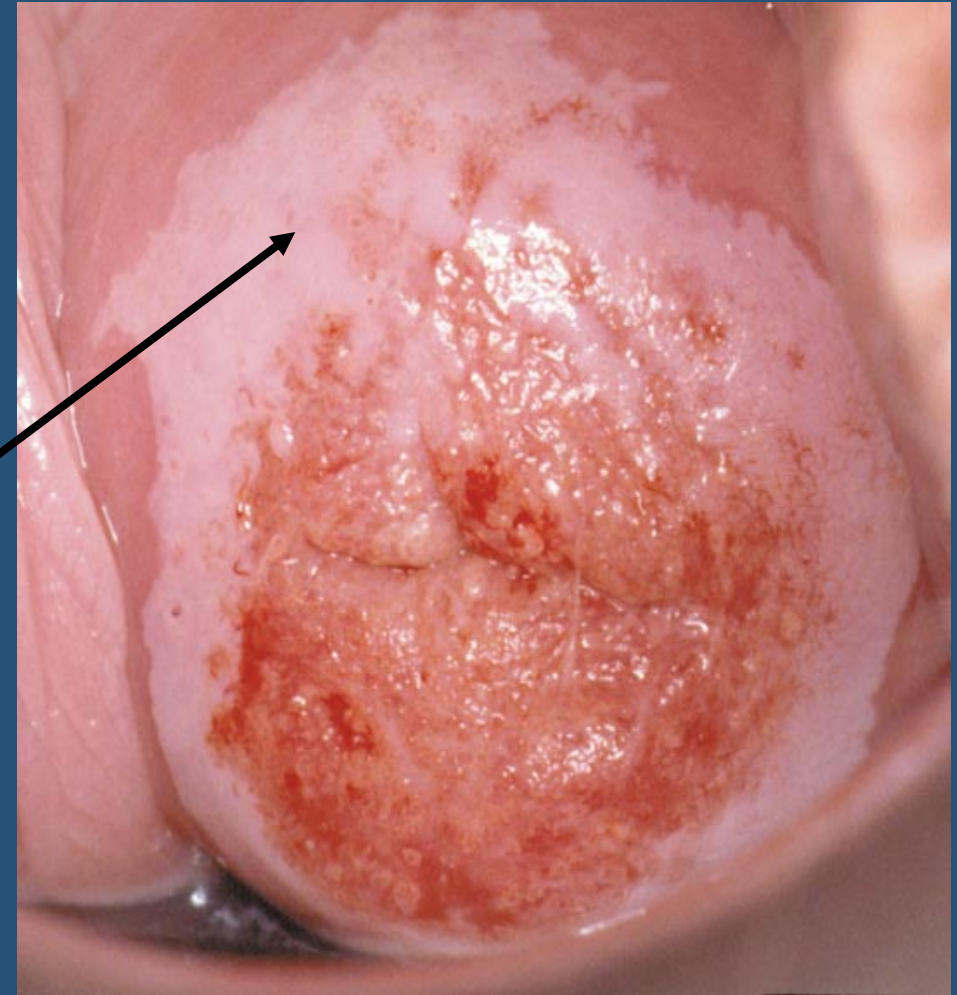
Squamous

Columnar



The SCJ “moves” centrally by the process of *squamous metaplasia*

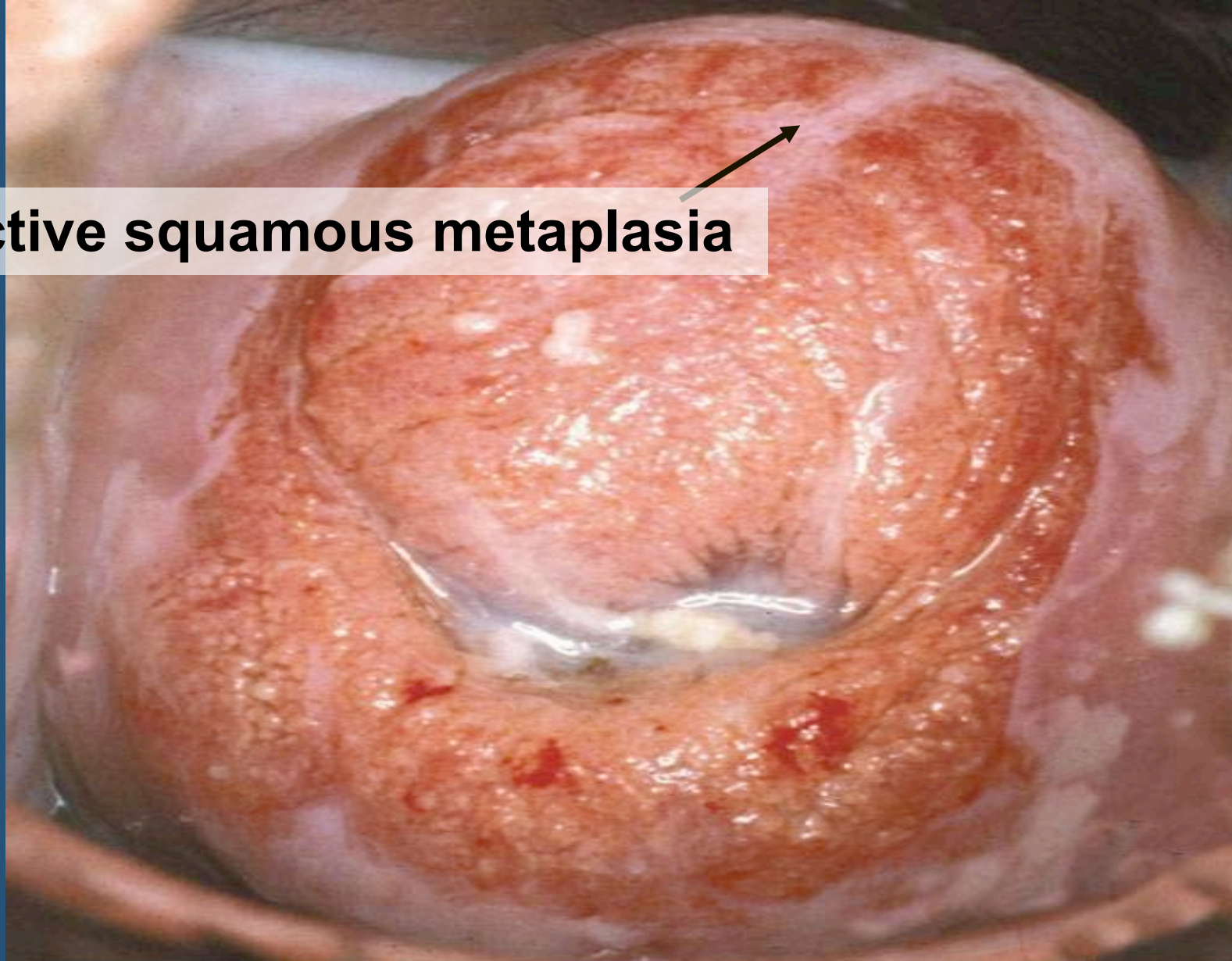
- Metaplasia: transformation of one cell type into another
- Squamous metaplasia is the process of transformation of columnar into squamous epithelium
- Squamous metaplasia is a *normal* process of cervical maturation

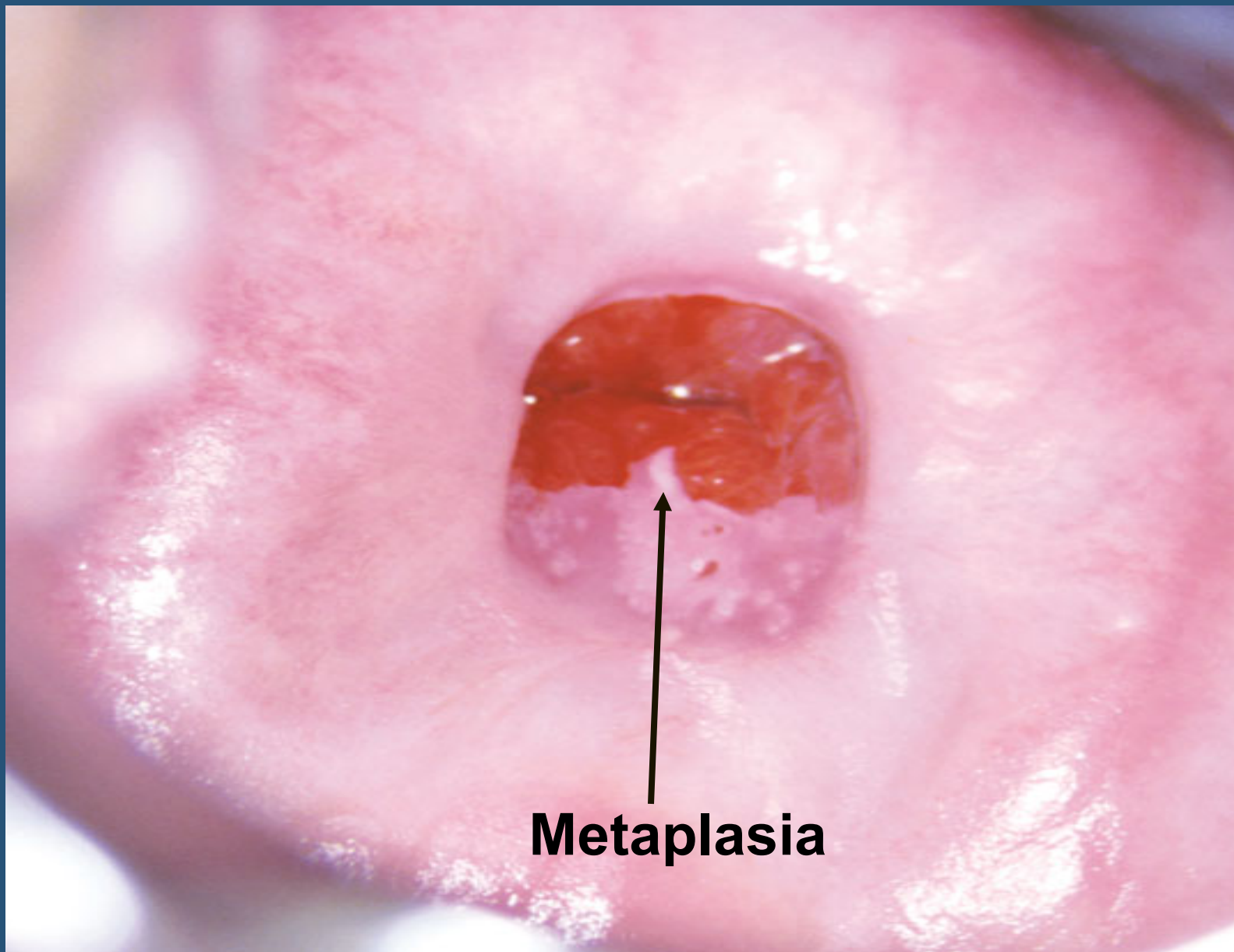


Mechanism of squamous metaplasia

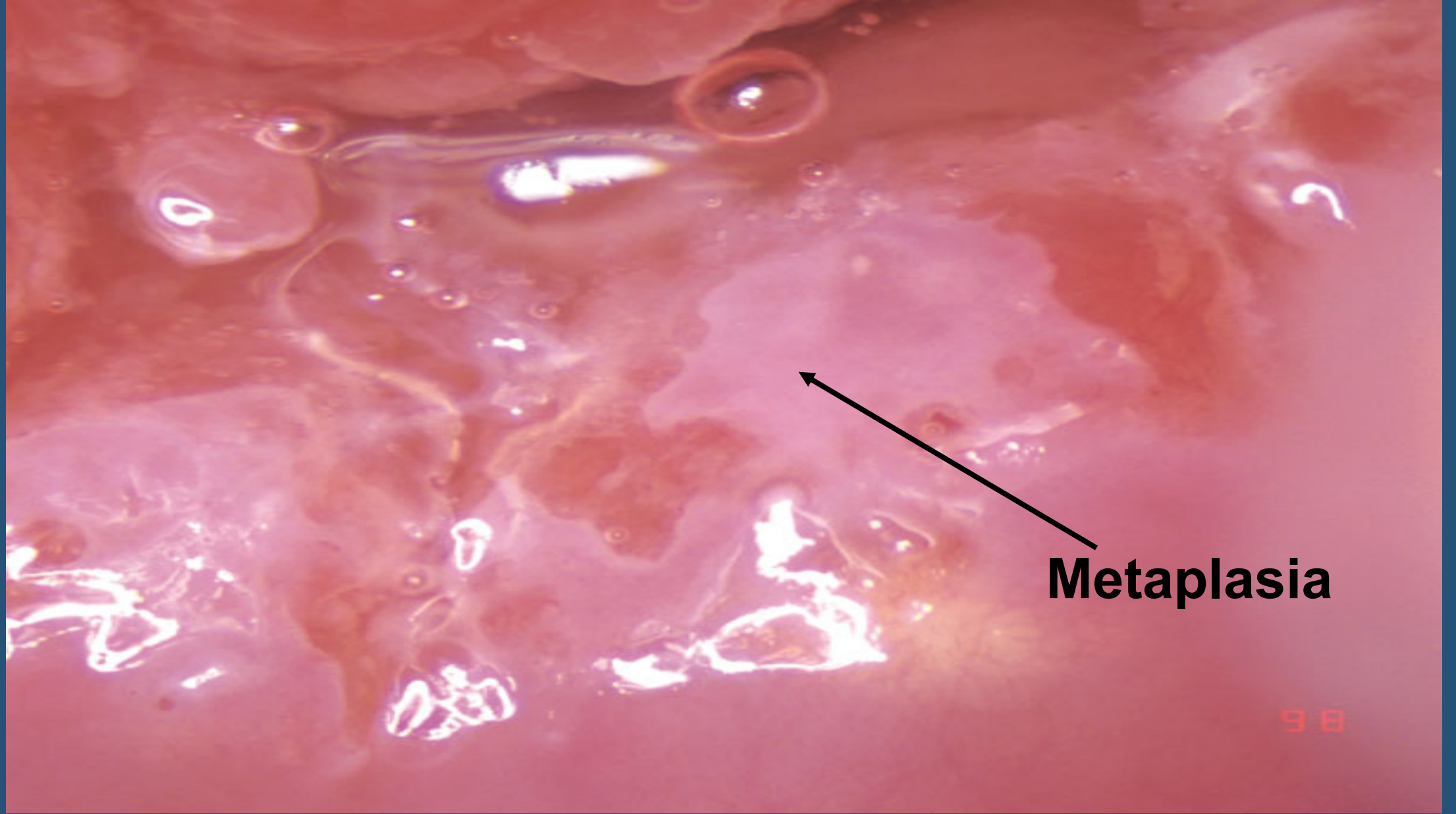
- Columnar cells changed into immature metaplastic cells
 - Become indistinguishable from squamous cells as they mature
- Transformation zone thought to arise from transformation of columnar epithelium through subcolumnar reserve cell hyperplasia
 - These reserve cells become metaplastic cells that then become the new squamous epithelium

Active squamous metaplasia





Metaplasia



Metaplasia

98

How squamous metaplasia occurs

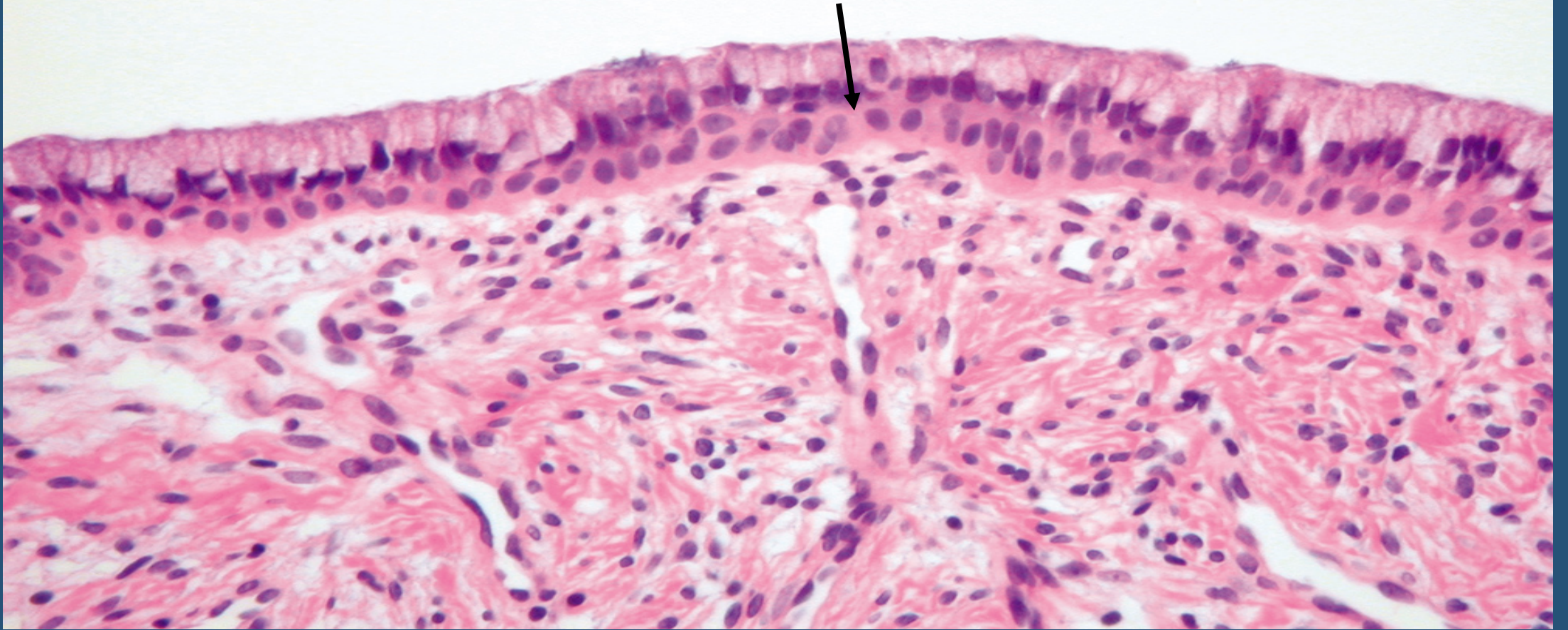
Mechanism of reserve cell hyperplasia

Estrogen lowers vaginal pH

- Estrogen levels increase in neonatal period and at puberty
- Cervical eversion mediated by estrogen
- Exposes endocervical columnar epithelium to more acidic vaginal environment
- “Acid burn” stimulates metaplasia of columnar epithelium

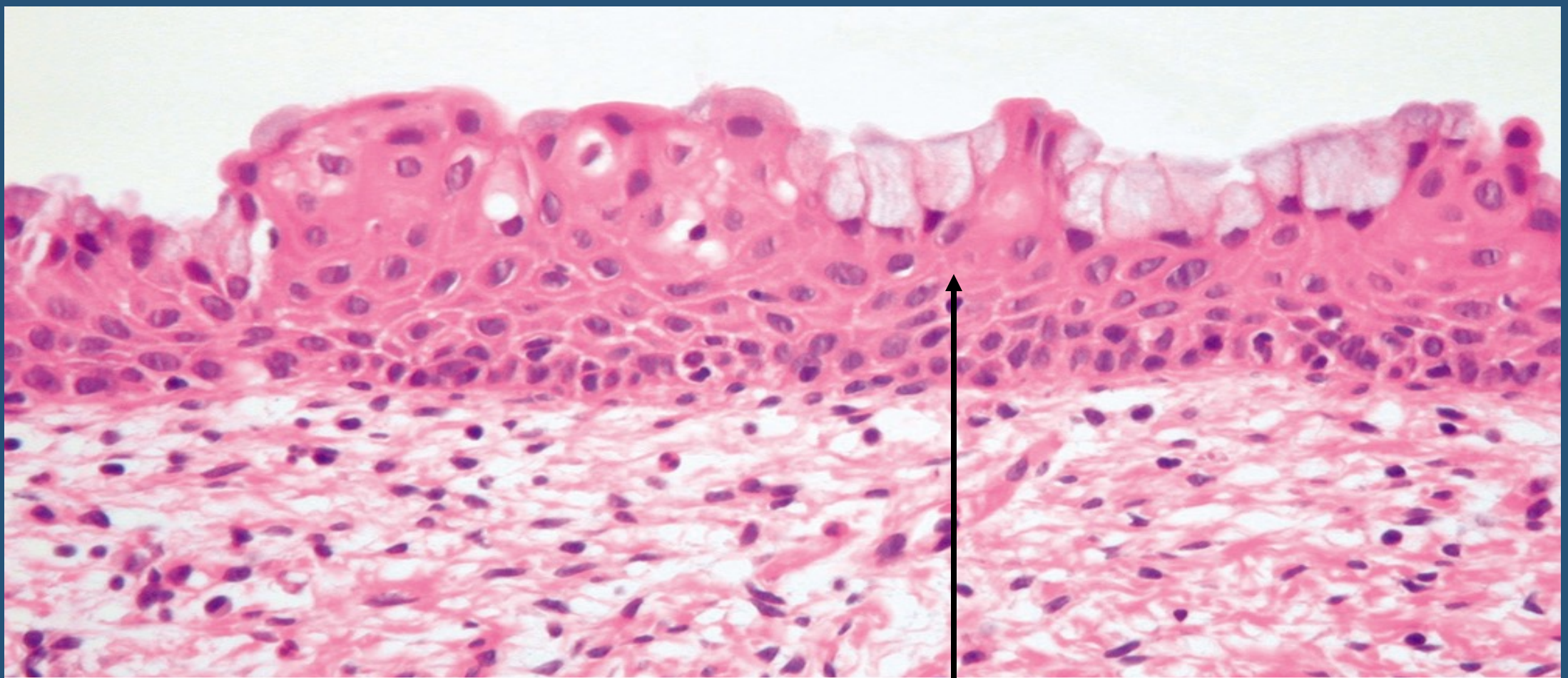
How squamous metaplasia occurs

Reserve cells below columnar cells



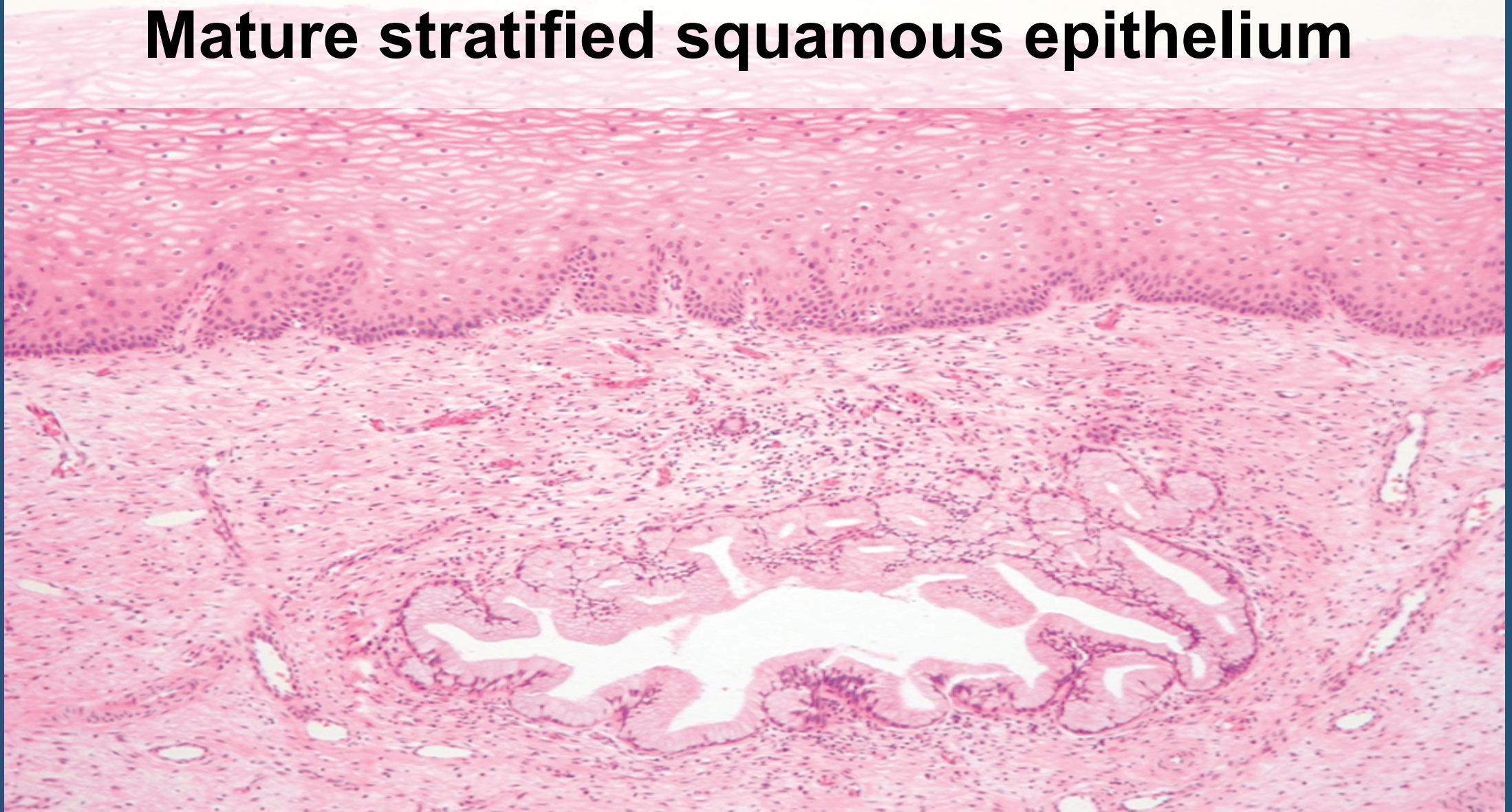
Factors inducing squamous metaplasia

- Etiologic factors
 - Mechanical irritation
 - Chronic inflammation
 - pH changes
 - Environmental conditions
- Probably begins when the original SCJ moves out of the os
 - Exposes delicate columnar cells to acidic vaginal environment



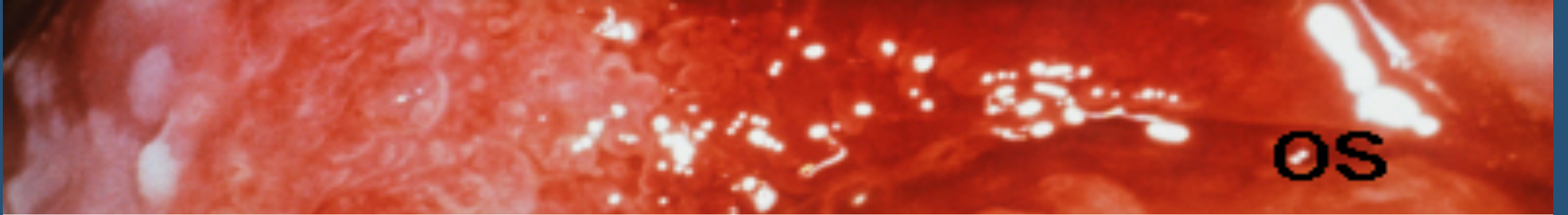
Proliferation of reserve cells - immature squamous cells directly below the remaining columnar cells

Mature stratified squamous epithelium

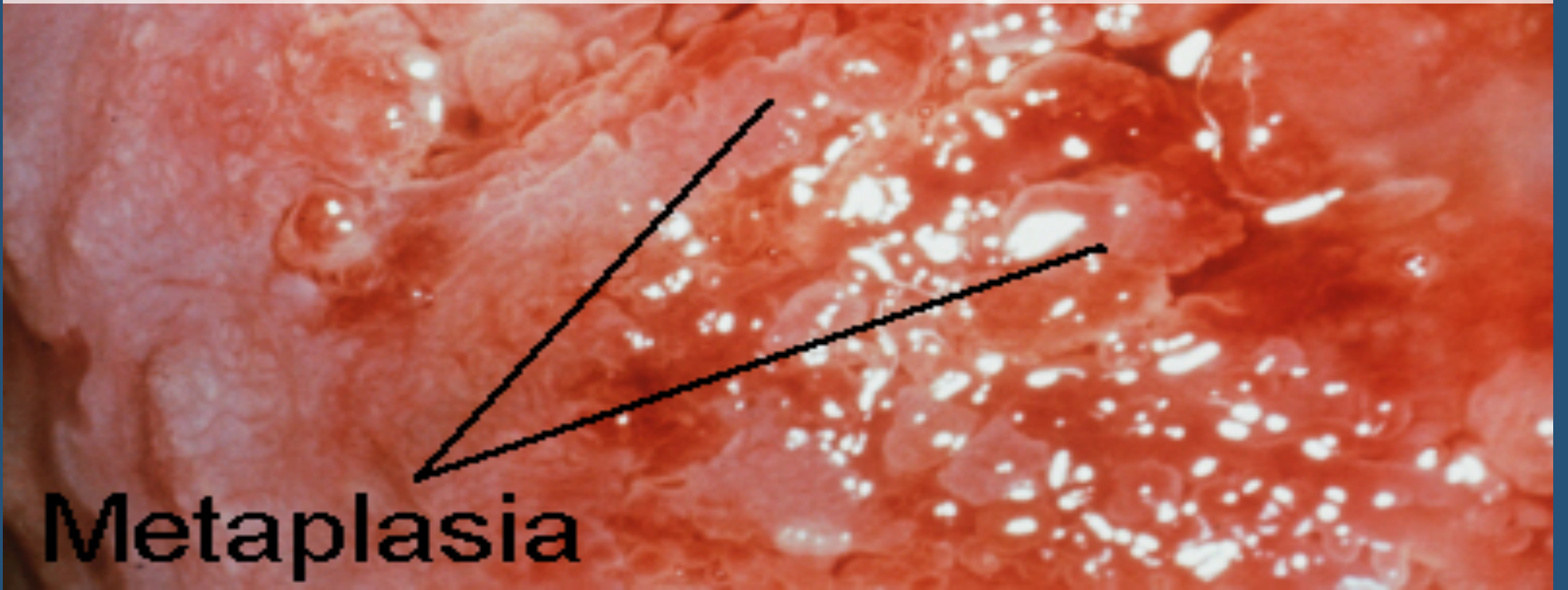


Squamous metaplasia

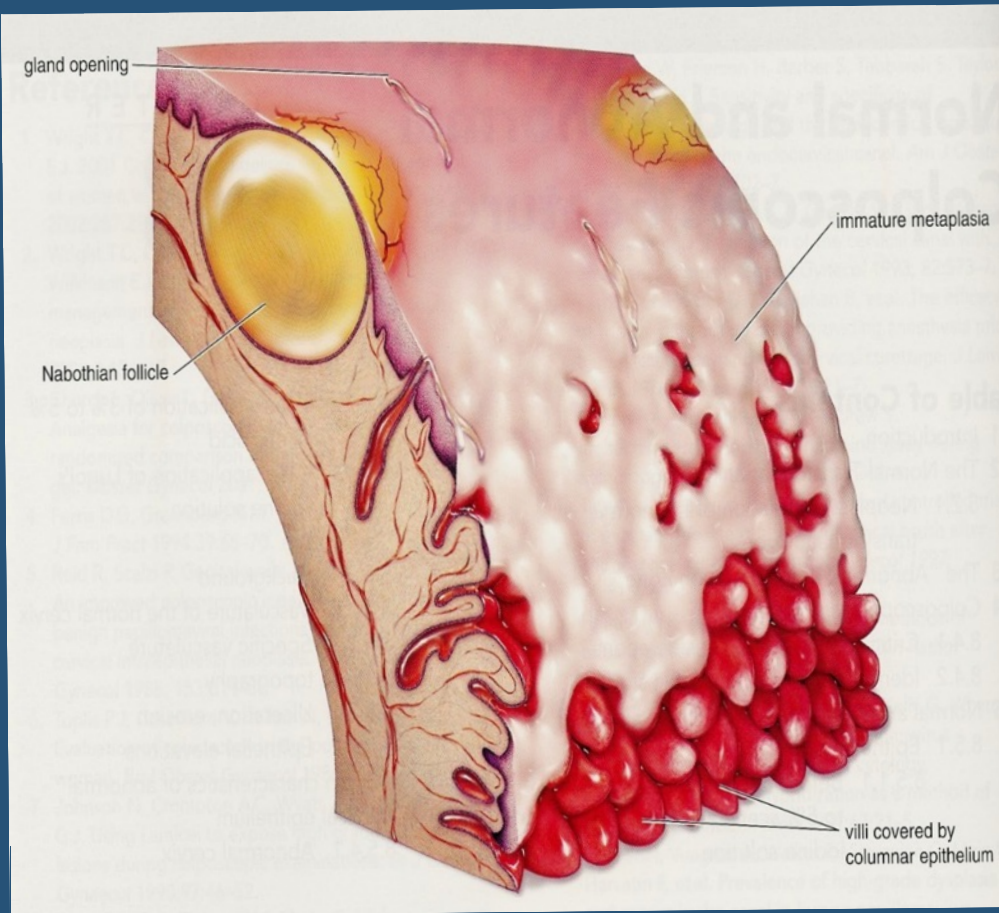
- Tips of columnar villi are traumatized by acidity of the vagina
- Immature cells gradually mature and the cells begin to produce glycogen
- Can be a random distribution on the cervix
 - Patchy, uneven areas of metaplasia
 - Immature tips have acetowhite appearance



Islands of metaplasia interspersed with columnar epithelium



Metaplasia

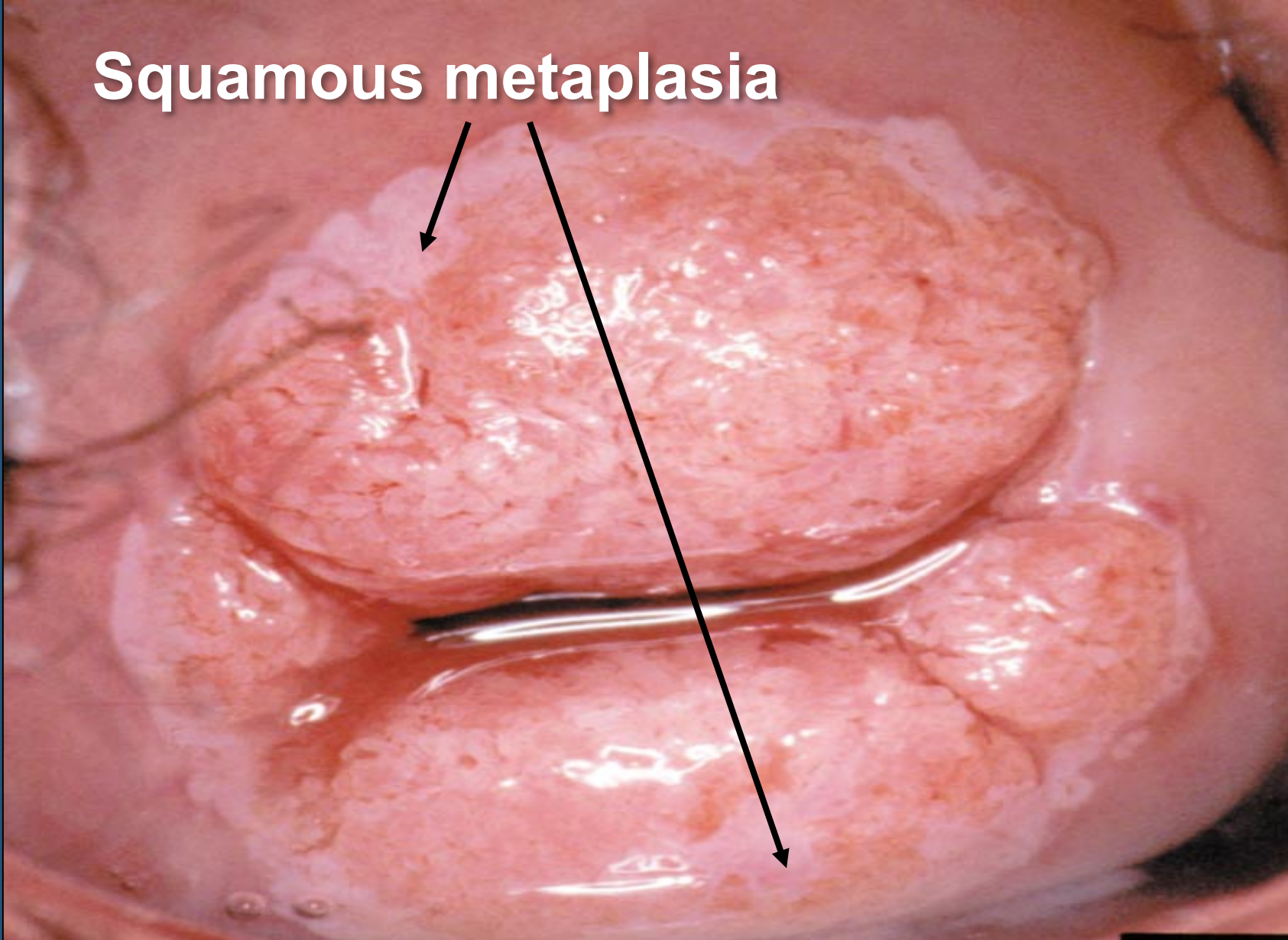


Normal transformation zone



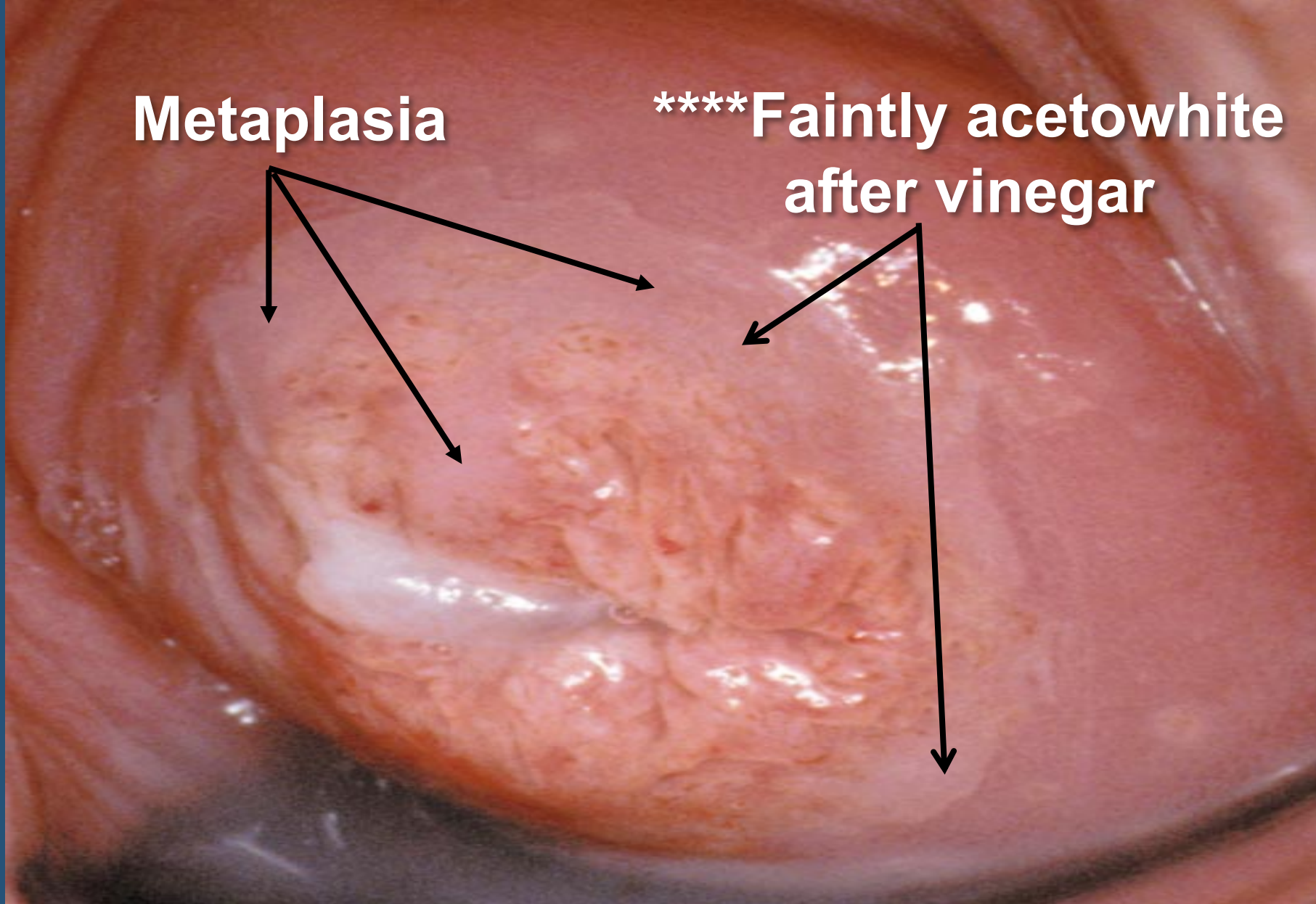
Mayeaux, E. J., & Cox, J. T. (2012). *Modern colposcopy: textbook & atlas*. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins.

Squamous metaplasia

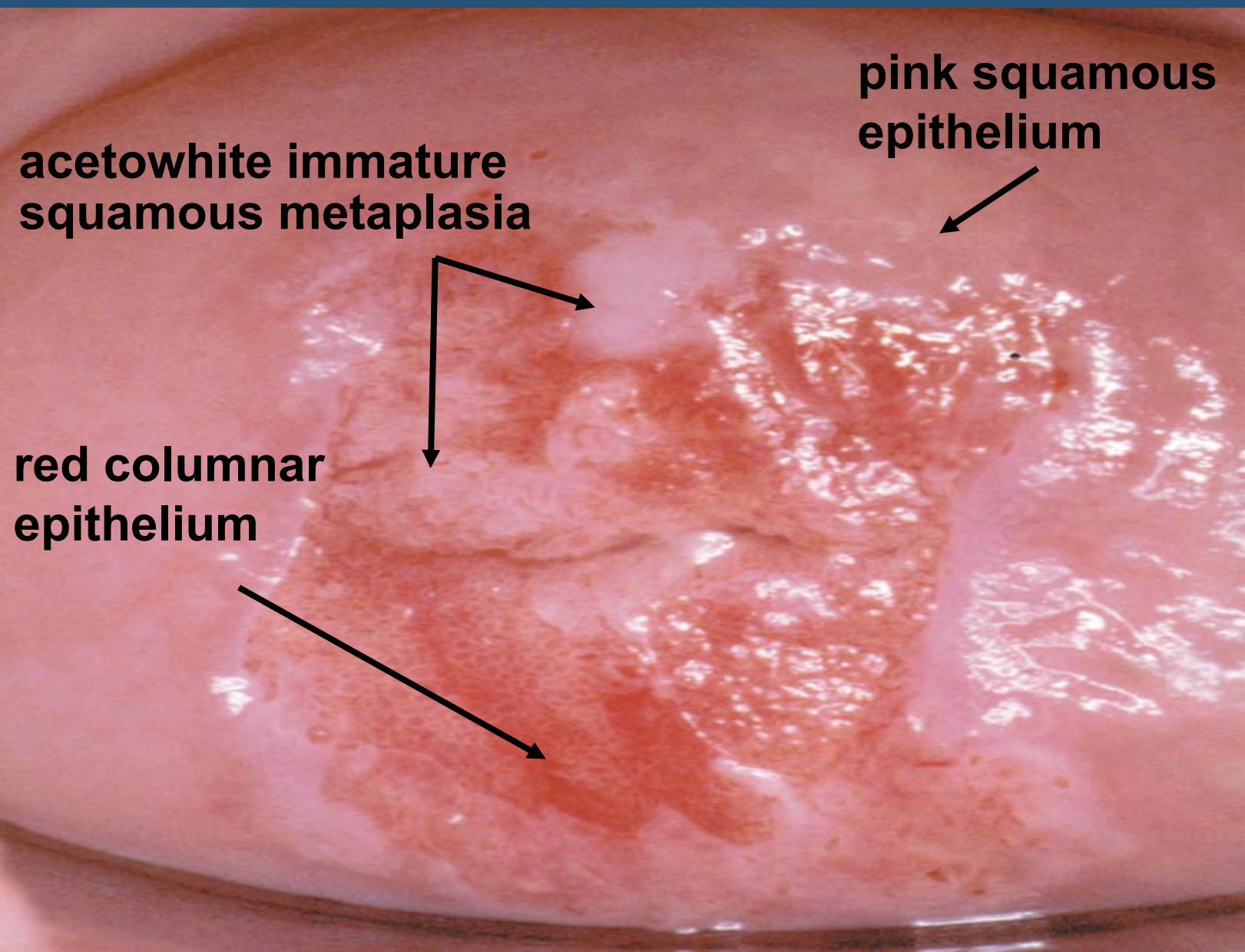


Metaplasia

******Faintly acetowhite
after vinegar**

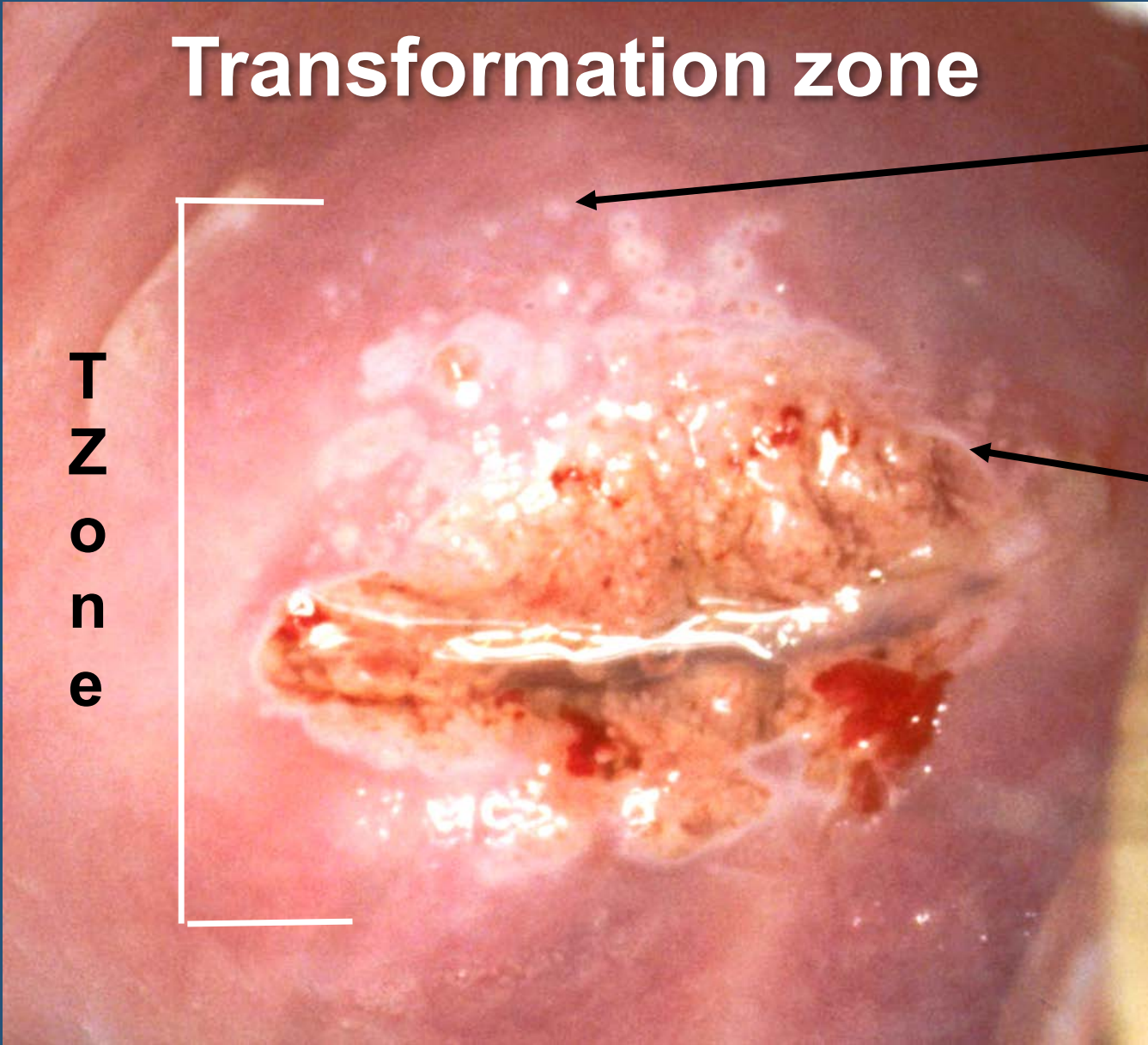


Colors of cervical epithelium



What is the transformation zone?

- Physical zone or area on the cervix
- Area between the original SCJ and the new SCJ
- TZ gets larger as the individual ages and remodeling or transformation occurs
- The new SCJ appears to “move” closer to the external os and then inside the endocervical canal
 - Process completed following menopause

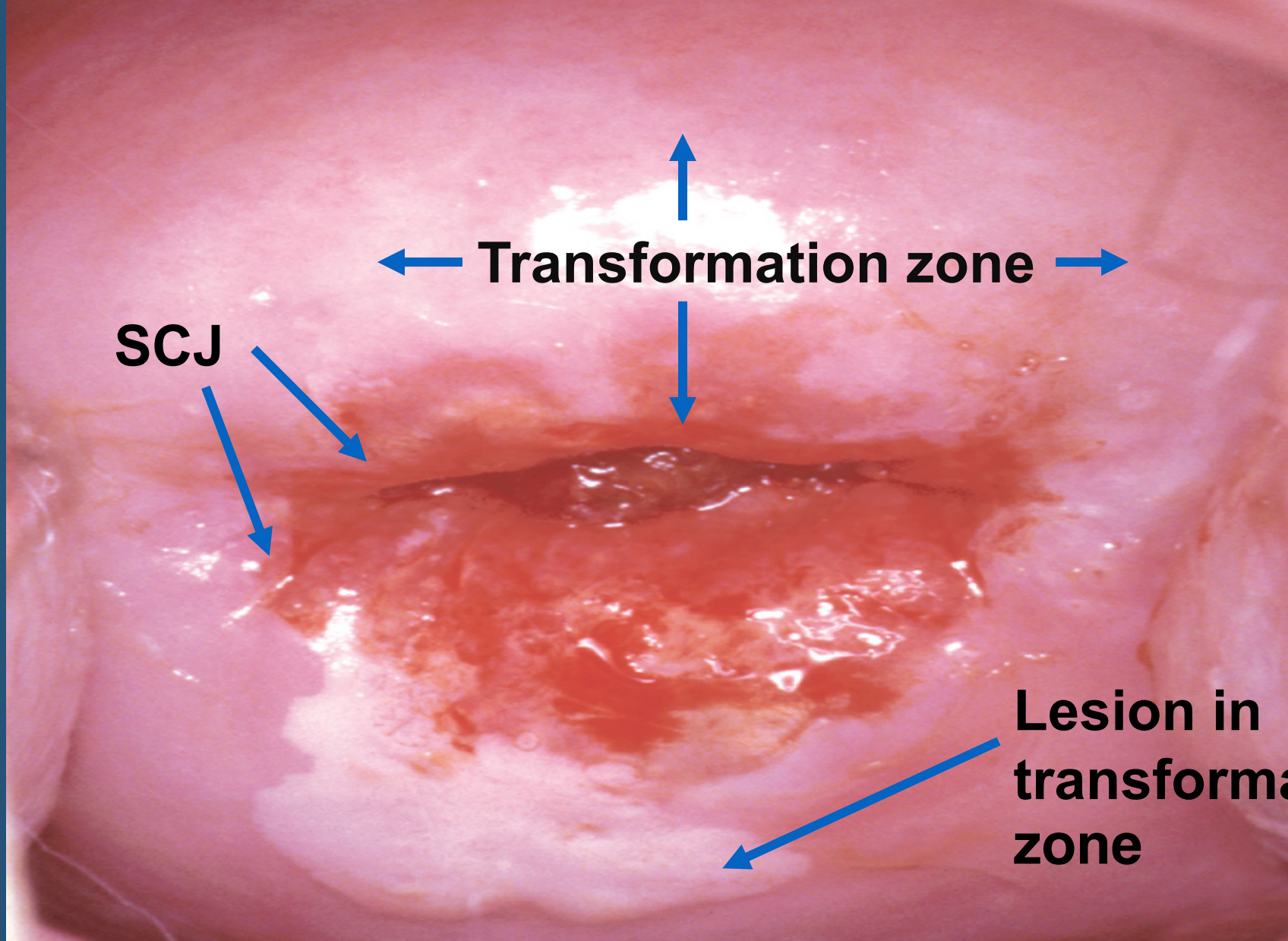


Transformation zone

Last gland opening

**T
Z
o
n
e**

**New
SCJ**



SCJ

← Transformation zone →

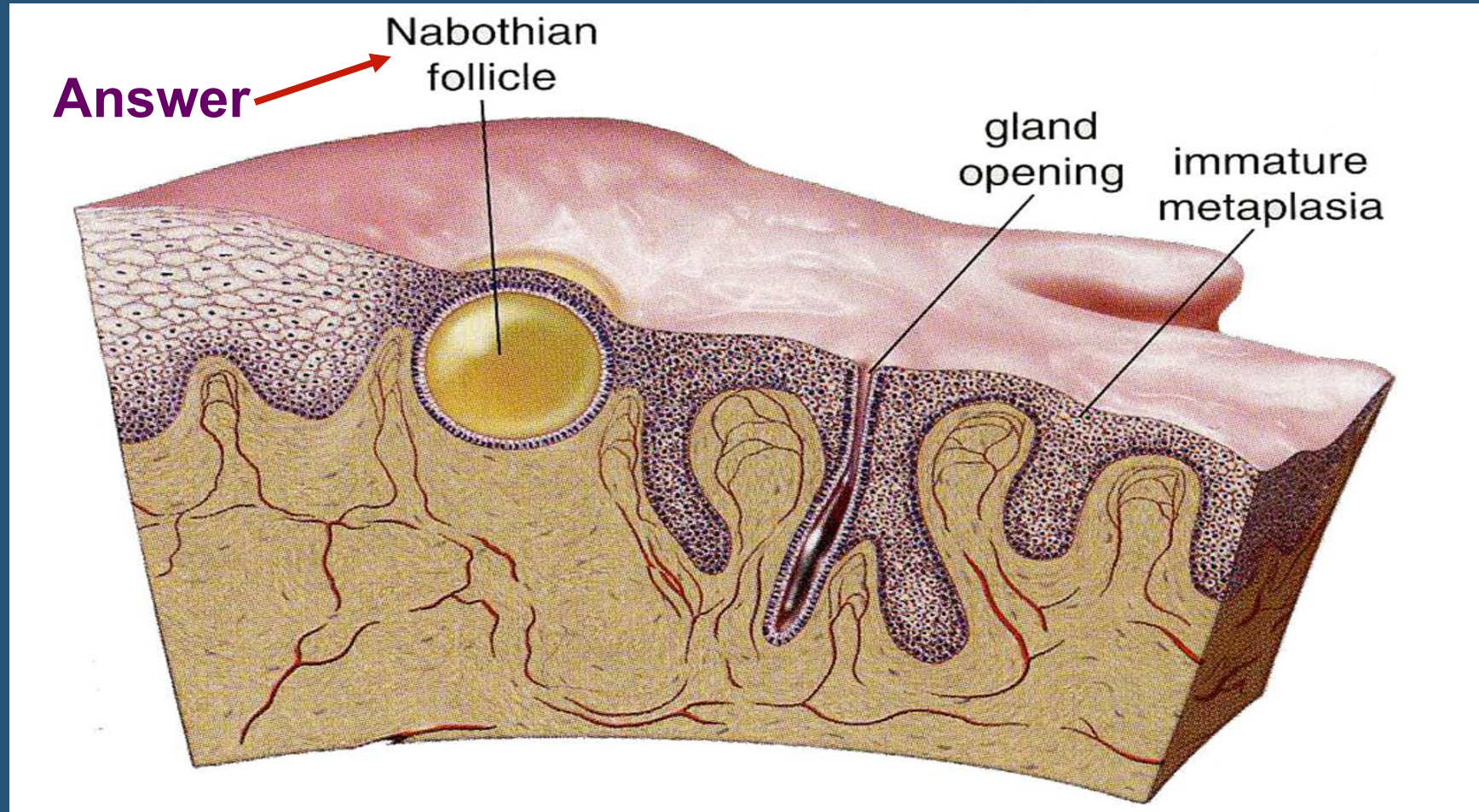
**Lesion in
transformation
zone**

Components of the TZ

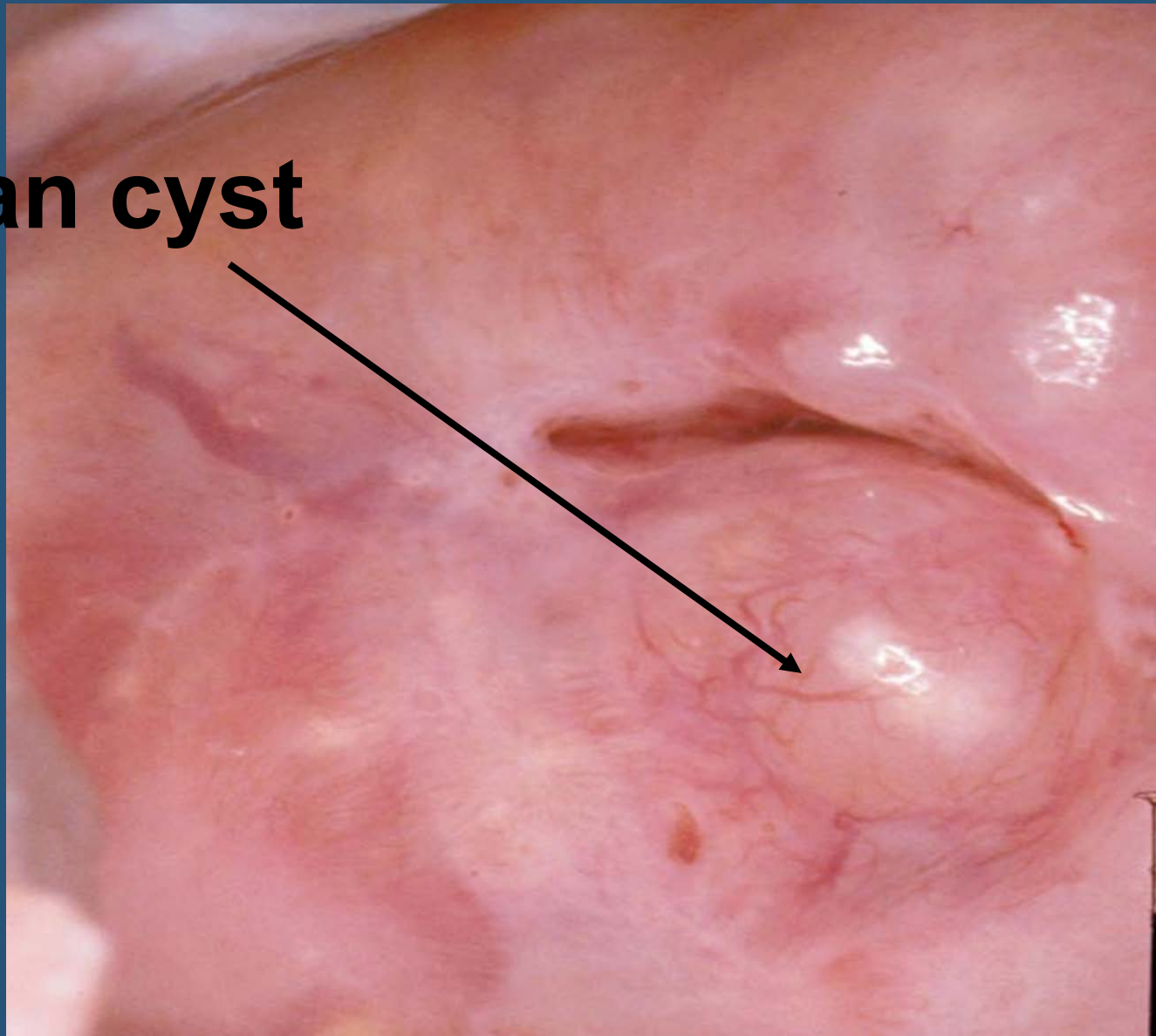
Nabothian cysts:

- Formed when the opening of the endocervical infoldings become blocked by metaplasia
- Accumulated mucus forms “cysts”
- Vessels accentuated over the cyst
- No treatment is necessary

What happens to those mucus secreting “glands” when they become blocked by squamous cells?

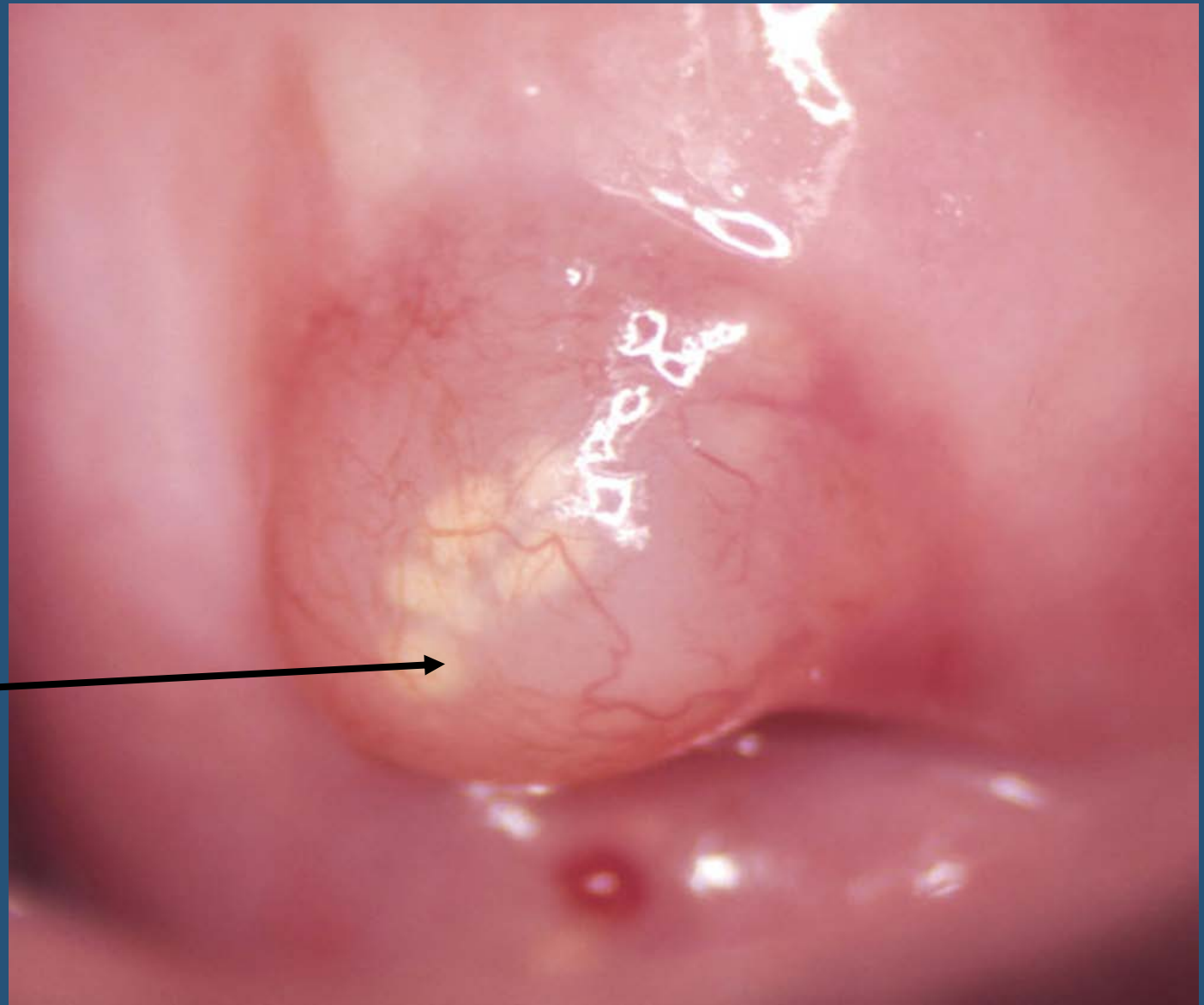


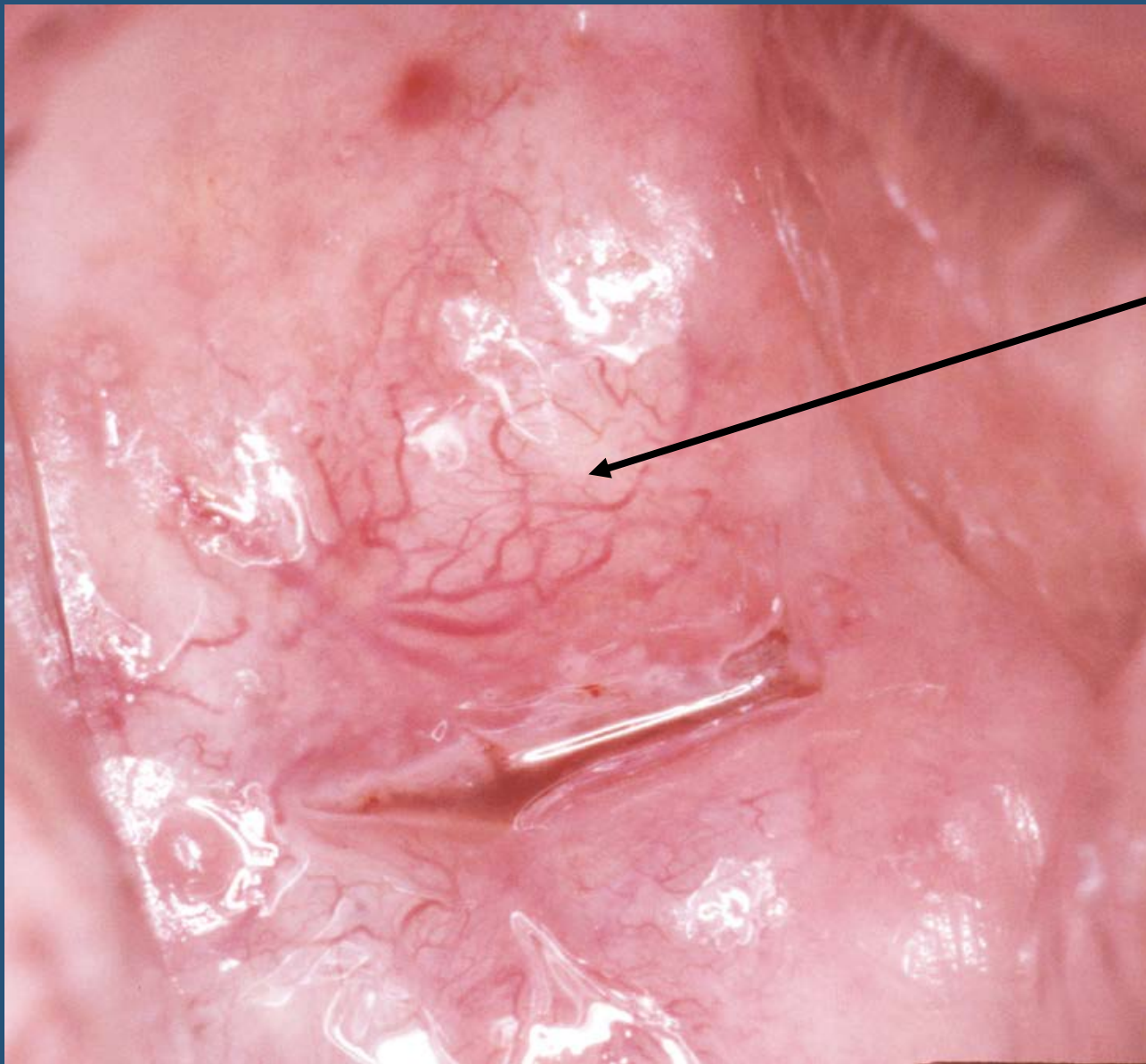
Nabothian cyst



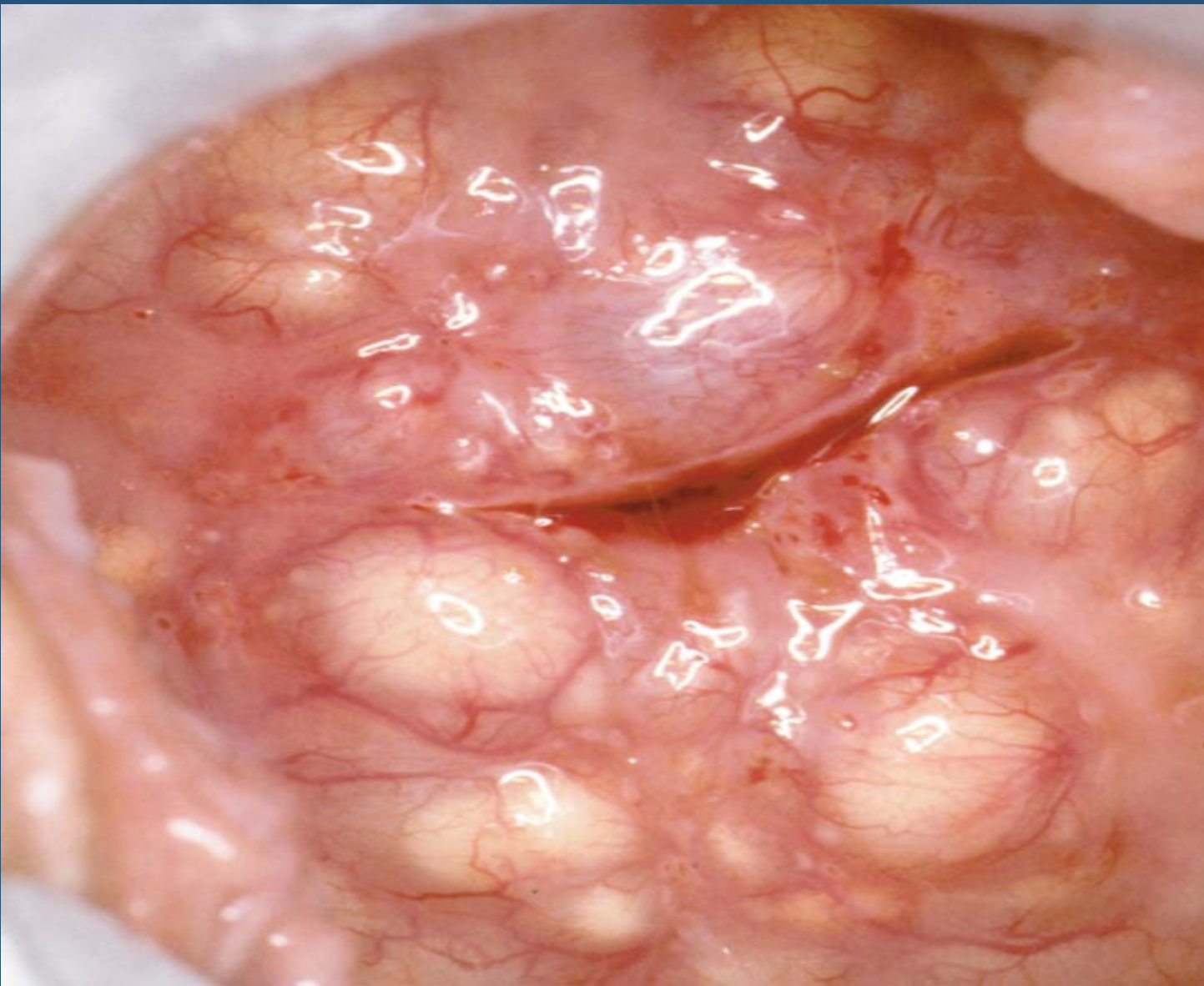
**Nabothian cyst:
good place to
learn normal
vessels**

**Branching vessels
Usually **yellow****





**Nabothian cyst
branching
vessels**

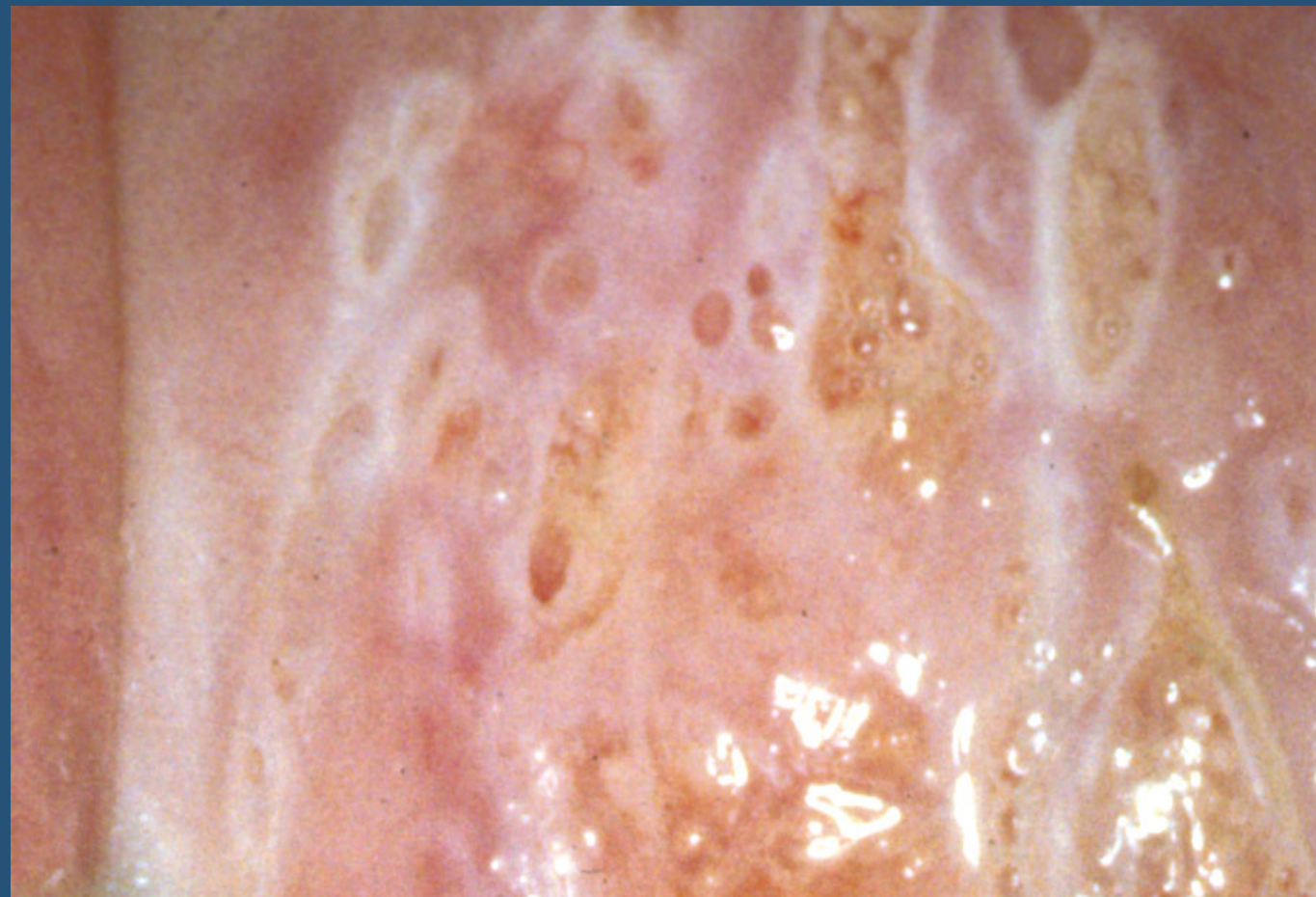


Multiple nabothian cysts

Components of the TZ

Islands of columnar epithelium

- Result from uneven process of squamous metaplasia
- Mini SCJ's
- If obliterate, may produce Nabothian cyst



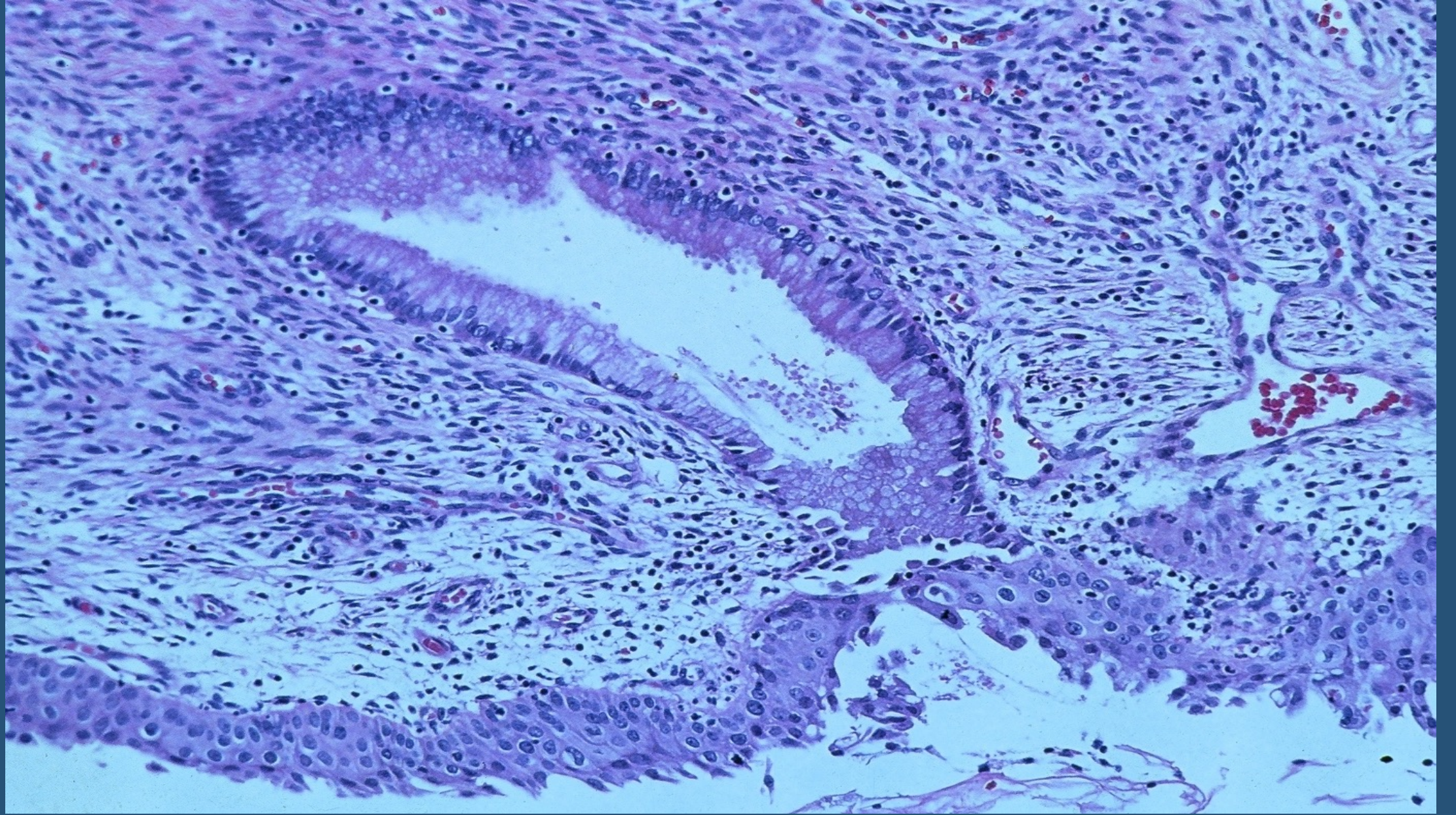
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Courses
Comprehensive Colposcopy

Components of the TZ

“Gland” openings with mucin secretion

- Not true glands
- Infoldings of columnar epithelium



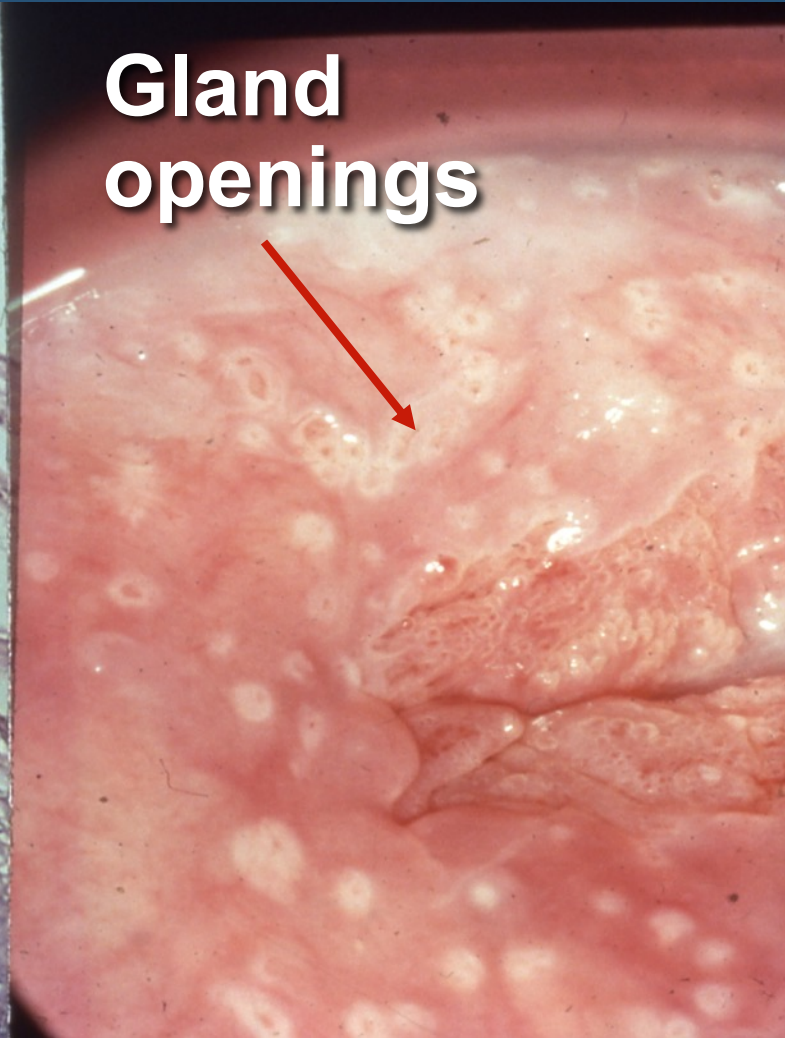
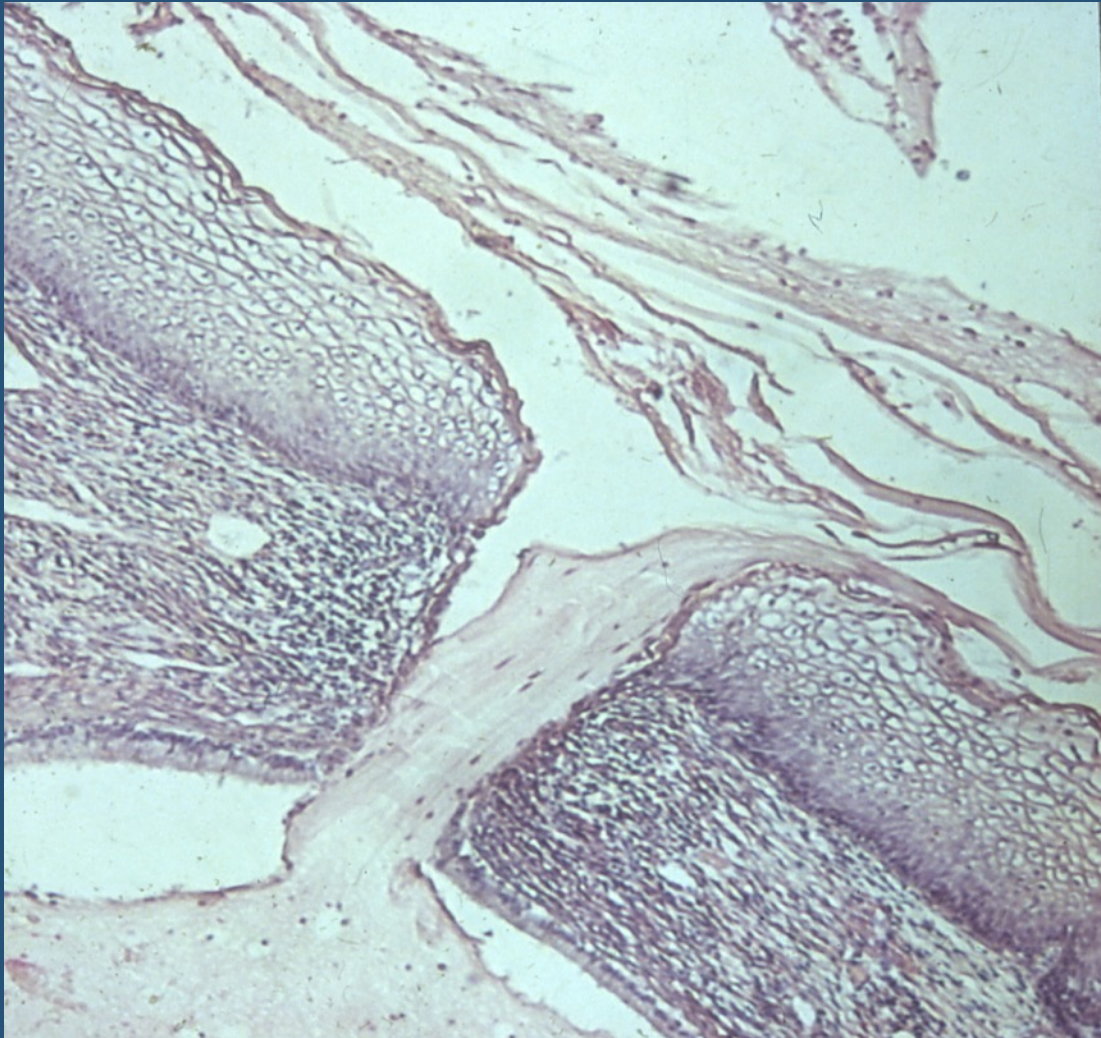
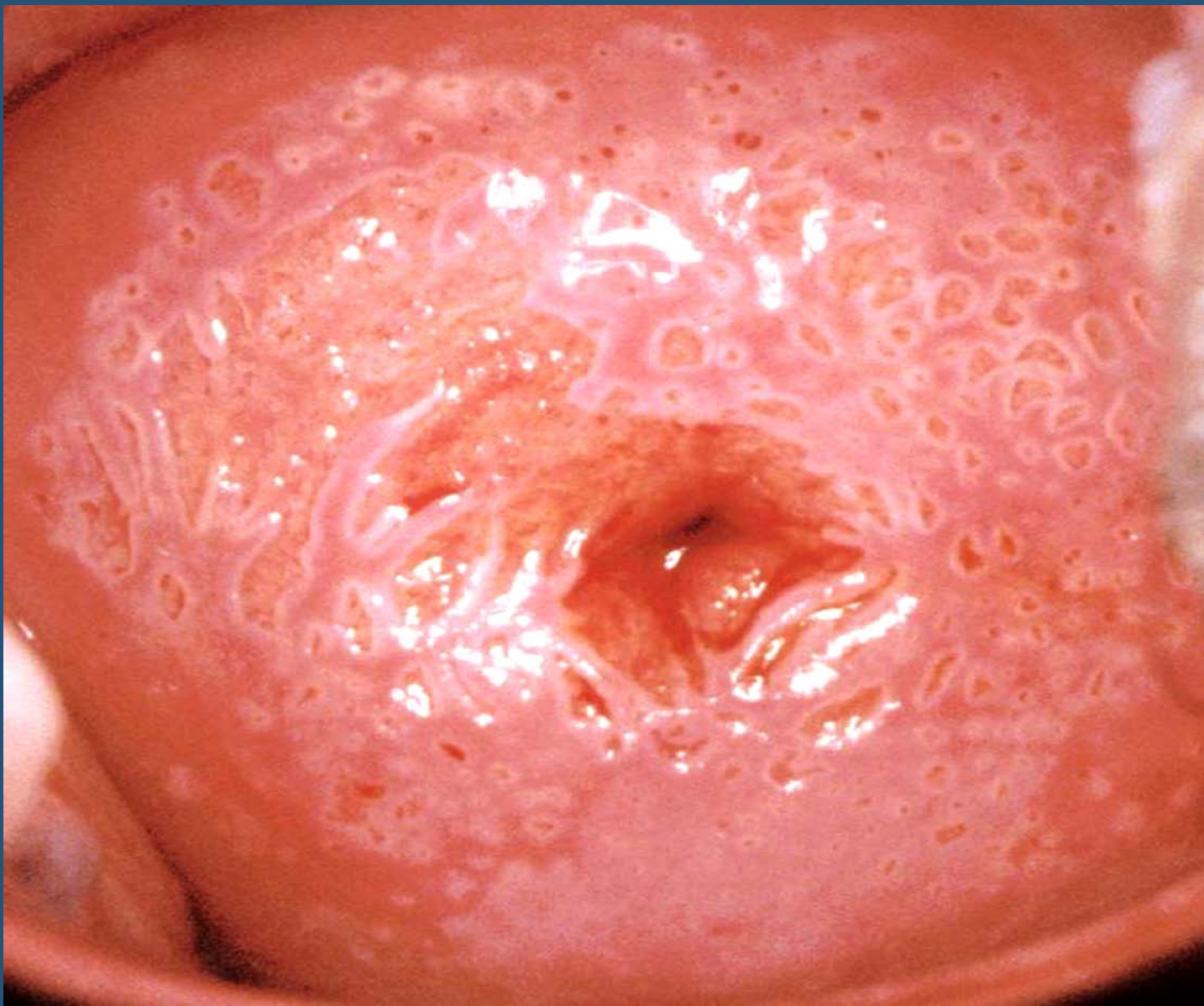


Image from Greenwald, Spitzer, Sedlis. ACOG Basic Colposcopy

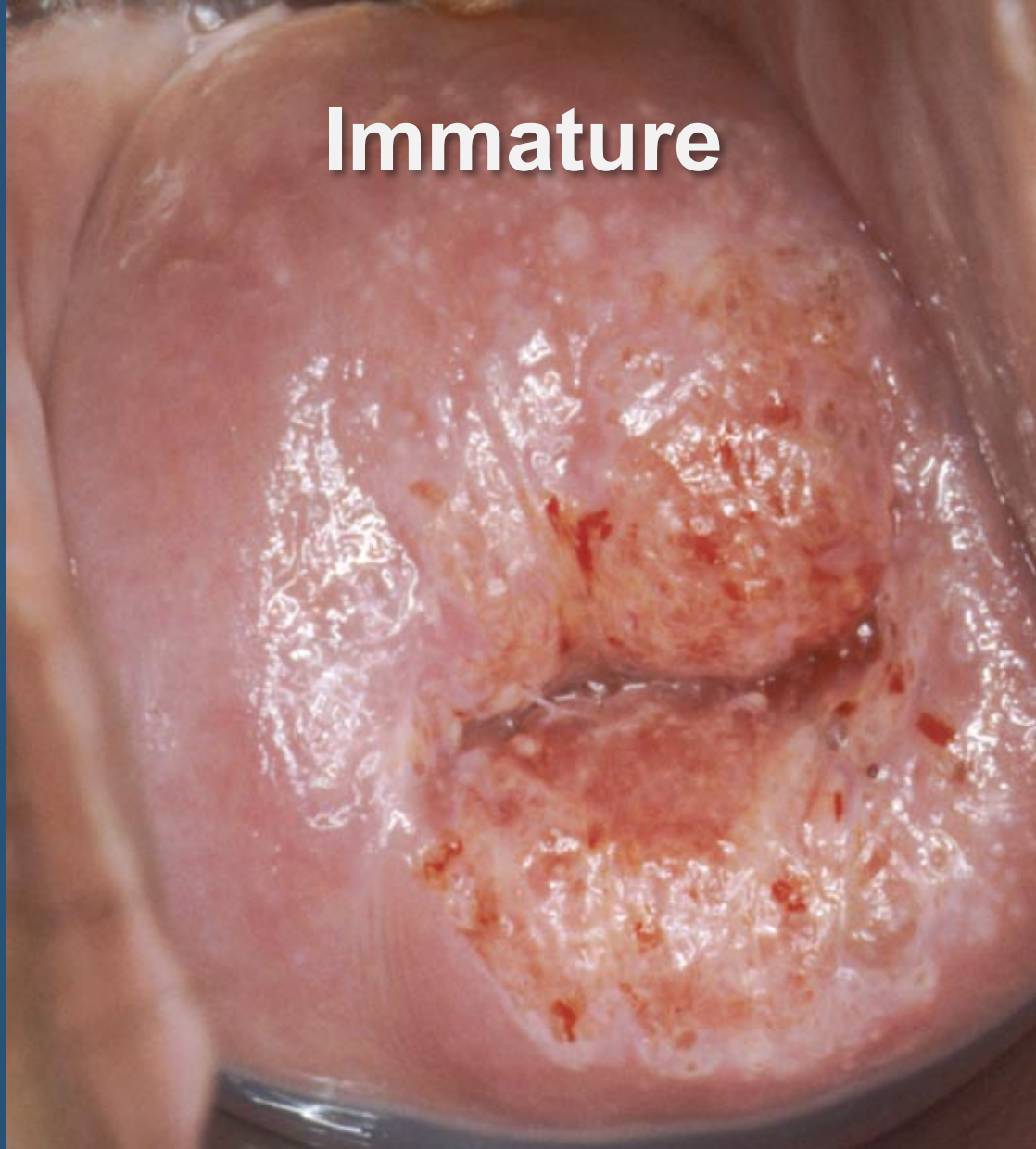


**Immature
metaplasia
with multiple
gland openings**

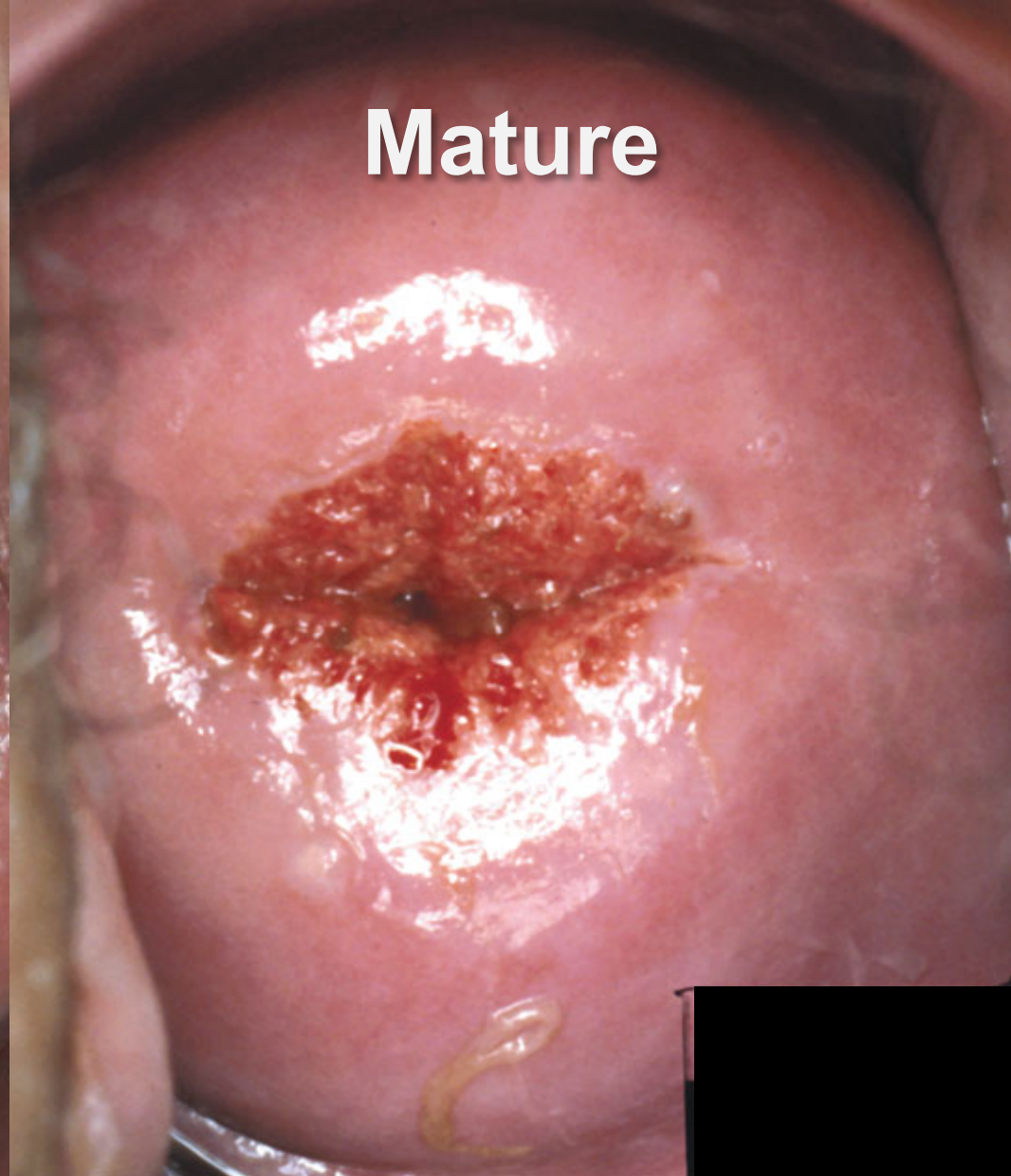
Components of the TZ

- Mature squamous epithelium
- Final result of squamous metaplasia
 - Original SCJ and squamous epithelium interface becomes a squamous-squamous junction

Immature



Mature



General assessment of the cervix and SCJ at the colposcopic exam: if fully visualized

- The entire new SCJ on the cervix can be visualized (360° of columnar epithelium)
- If any lesion is visible, must see it entirely
- May require manipulation or endocervical speculum for complete visualization

Is the general assessment of the SCJ and lesions fully visualized?

Fully Visualized



Not Fully Visualized



Summary

- Reviewed the epithelial features of the normal transformation zone
- Discussed the process of squamous metaplasia
- Explained the normal features of the transformation zone according to age
- Described features that define a fully visualized cervix and SCJ at colposcopy