Breast Development and Anatomical Variations

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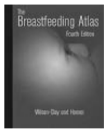
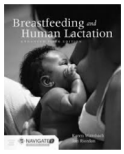
Objectives

- Summarize the embryology of the human breast (fetal development)
- Summarize further mammogenesis (from birth to puberty)
- Enumerate anatomical variations of the breast

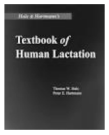
Sources (books)



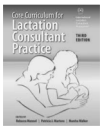
'The BF Atlas'
Wilson-Clay & Hoover,
4th Edition (2008)
and CD from 2nd edition



'BF and Human Lactation'
J. Riordan & K. Wambach
5th Edition (2016)



'Textbook of Human Lactation'
Thomas Hale & Peter Hartmann
1st Edition (2007)



'Core Curriculum'
ILCA
3rd Edition (2013)

Breastfeeding – A Guide for the Medical Profession
By Ruth Lawrence and Robert Lawrence (2011, 7th Ed.)

PLAN

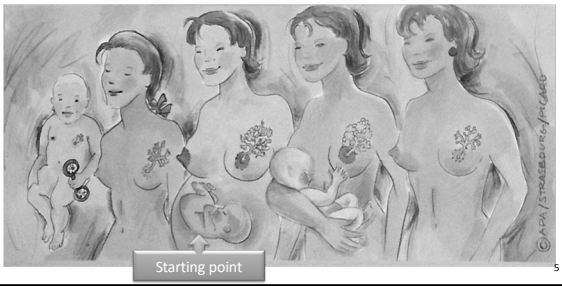
Introduction

A. Breast development
   - Embryonic and fetal development
   - Further mammogenesis

B. Anatomical variations

Introduction

The mammary gland begins development early in embryologic life and only culminates in the postpartum lactation of the adult female.



Action pour l'Allaitement, France

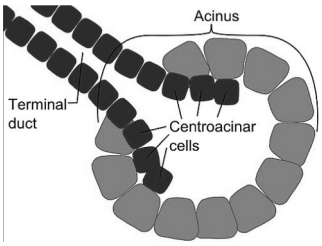
Starting point

Introduction (cont.)

- During **4th week** of embryologic development, formation of **multi-layered skin** present at birth.
- Specialized structures formed by the epidermis outgrowing into the dermis, i.e. 'epidermal glands' begin to appear.
- One of them, the mammary gland is an **exocrine gland** with **apocrine secretion**.

Introduction (cont.)

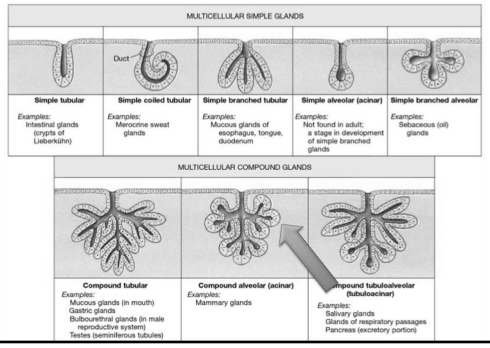
Exocrine glands: produce and secrete substances onto an epithelial surface by way of a duct.



https://en.wikipedia.org/wiki/Exocrine_gland#/media/File:Centroacinar_cells.jpg

Introduction (cont.)

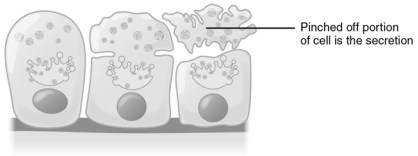
Exocrine glands vary in complexity.



https://slideplayer.com/slide/7629228/

Introduction (cont.)

Apocrine secretion: the release of secretory materials is accompanied with loss of part of cytoplasm.



https://en.wikipedia.org/wiki/Apocrine#/media/File:405_Modes_of_Secretion_by_Glands_Apocrine.png

The mammary gland is a **modified and highly specialized type of apocrine gland**.

 https://en.wikipedia.org/wiki/Apocrine

Introduction (cont.)

- **Embryologic development** of the mammary gland:
  - series of **highly ordered events**
  - involving **interactions among a number of distinct cell types**
  - regulated by an array of systemic and local factors such as **growth factors and hormones**.
- Development is initially identical among males and females of the same species.

PLAN

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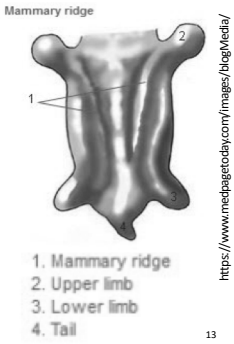
Fetal development: an overview

Gestational Age	Stage of Development of the Breast
4 weeks	Appearance of mammary streak [Lawrence]
5-6 weeks	Appearance of ectodermal ridge (milk line)
7-8 weeks	Mammary disc appears Primitive blood vessels are formed
10-12 weeks	Formation of epithelial buds
16 weeks	Mammary vascular system completely formed
13-20 weeks	Parenchymal branching of the buds
20 weeks	15-20 solid cords (ductal structures) formed
32 weeks	Canalization of the solid cords completed to form primary milk ducts
32 weeks-term	Some lobulo-alveolar development Increased periductal stroma Lobules have a single layer of epithelium

 Hale & Hartmann 2-1 & Lawrence Table 2-1

From 4th week: Mammary streak/ridges

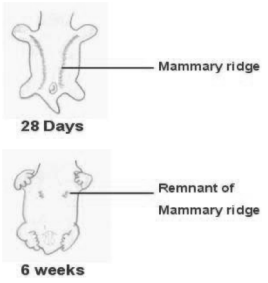
- Paired ectodermal thickenings termed **mammary ridges** or **milk lines** develop on the ventral surface of the embryo and extend in a curvilinear fashion convex towards the midline from the axilla to the medial thigh.



https://www.medpagetoday.com/images/blogMedia/celebritydiagnosis/milkline.jpg

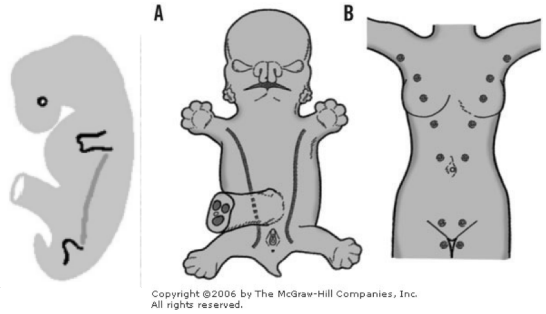
Mammary streak/ ridges (cont.)

- This is the first morphologic evidence of mammary gland development.
- In normal human development, these ridges disappear **except at the level of the fourth intercostal space** on the anterior thorax, where the mammary gland subsequently develops.



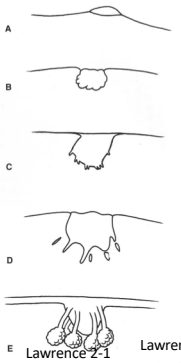
https://www.ceessentials.net/article40.html

Milk lines



http://ueu.co/wp-content/uploads/2014/09/loadBinaryCA1LDGWU.jpg

Nipple development



A: Thickening of epidermis with formation of **primary bud**.

B: Growth of bud into mesenchyma.

C: Formation of solid **secondary buds**.

D: Formation of mammary pit and vacuolation of buds to form epithelial-lined ducts.

E: Lactiferous ducts proliferate. Areola is formed. Nipple is inverted initially.

Lawrence 2-1 Lawrence & Lawrence

20 weeks gestation: ducts appear

- Small lumina develop within the buds (through apoptosis of the central epithelial cells)

- Coalesce and elongate to form the lactiferous ducts.

https://www.reddit.com/r/pics/comments/9a0qf3/picture_of_a_fetus_in_utero_from_lennart_nilsons/

20 weeks : ducts appear (cont.)

- The canalization of the mammary buds with formation of the lactiferous ducts is induced by placental **hormones** entering the fetal circulation.
- These hormones include progesterone, growth hormone, insulin-like growth factor, estrogen, prolactin, adrenal corticoids, and triiodothyronine.

Overview of fetal breast development

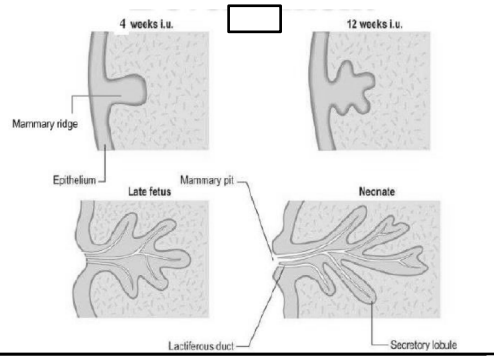


image from image.slidesharecdn.com/breastanatomy

PLAN

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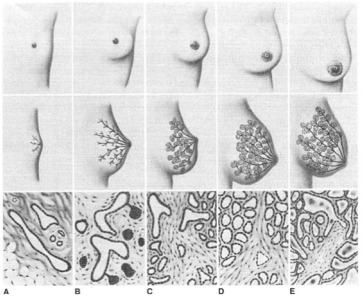
Mammogenesis

- Is defined as growth and differentiation/development of the mammary gland to the stage prior to active secretion. [BF & HL]
- The mammary system is unlike other organ systems: from birth through puberty, pregnancy and lactation, no other human organ* displays such dramatic changes in size, shape, and function as does the breast.

* Except perhaps the uterus

Mammogenesis after birth



- A: infancy
- B: puberty
- C: adult breast
- D: pregnancy
- E: lactation

Lawrence Figure 2-3

At birth

- Approximately **15-20 lobes** of glandular tissue have formed, each containing a lactiferous duct.
- Support for the breast:
  - skin envelope
  - and the fibrous suspensory ligaments of Cooper

http://www.breastfeeding-problems.com/cluster-feedings.html

At birth (cont.)

- The nipple appears as a **small pit** in the center of a thickened areola containing a few glands of Montgomery.

IBFAN Calendar

At birth (cont.)

- Immediately after birth, the newborn's breast may be swollen and secreting small amount of milk *(witch's milk).*
- Common among male and female infants

http://www.pediatricsconsultantlive.com/photoclinic/galactorrhea-newborn-witch%E2%80%99s-milk

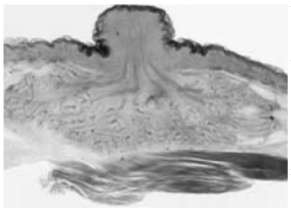
At birth (cont.)

- Caused by the stimulation of the infant's mammary glands by the same hormones produced by the placenta to prepare the mother's breast for lactation.
- This secretory activity subsides within 3 to 4 weeks, then the mammary glands are inactive until shortly before the onset of puberty.

Do not press on the gland…

At birth (cont.)

- Progressively, the **nipples become everted** (proliferation of the surrounding mesoderm),
- Areolae develop a slight **increase in pigmentation**.
- Development of **erectile tissue** in the nipple areolar complex → further protrusion upon stimulation.



http://vmouse.ucdavis.edu/hparecord/21/development.html

At birth (end)

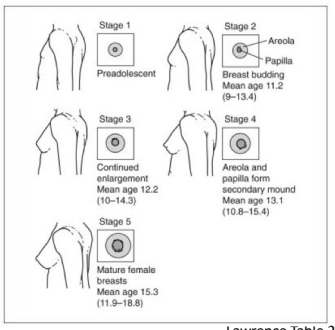
- Failure of the nipples to evert → **inverted nipples**
  - tethered by fibrous bands and a hypoplastic ductal system
  - can occur in males and females, but clinically significant for breastfeeding (latch problems).
- Any trauma, incision, radiotherapy to breast bud can trigger maldevelopment with **hypoplasia** (→ later affects milk supply).

Phases of pubertal breast development (Tanner)

Phase	Age (year)	Developmental Characteristics
I	Puberty	Preadolescent **elevation of nipple** with no palpable glandular tissue or areolar pigmentation.
II	11.1 ± 1.1	**Breast bud**: presence of glandular tissue in subareolar region; nipple and areola project as single mound from chest wall.
III	12.2 ± 1.09	Increase of amount of readily palpable glandular tissue, with **enlargement of breast** and increased diameter and pigmentation of areola; contour of breast and nipple remains in single plane.
IV	13.1 ± 1.15	Enlargement of areola and increased areola pigmentation: nipple and areola **form secondary mound above breast level.**
V	15.4 ± 1.7	Final adolescent development of **smooth contour with no projection of areola and nipple**.

Lawrence Table 2-3

Phases of pubertal breast development (Tanner)



https://circumscience.files.wordpress.com/2015/03/tanner-stages-girl-07.jpg

Lawrence Table 2-3

Mammogenesis (cont.)

- Breasts keep pace with physical growth
- Ductular, lobular growth, surrounding fat pad continues; ducts, lobes and alveoli.

Childhood

Hormonal influences: see session 'Physiology'

Onset of menses

- Primary/ secondary ducts grow and divide.
- Terminal end buds form (alveoli)
- Proliferation/ active growth with each cycle

Pregnancy

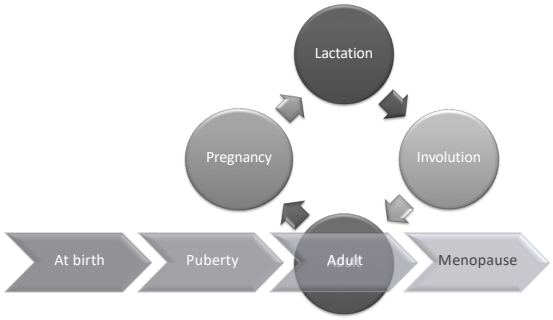
- Complete development (mainly lactocytes)

After weaning…

- Post-lactational changes present up to 5 years after cessation of lactation:
  - Involution of lobules
  - Infiltration by lymphocytes and plasma cells

Action pour l'Allaitement, France

The cycle can continue, until…



At menopause

- Menopausal involution:
  - Involution of lobules
  - Remaining mostly ducts, adipose tissue, and connective tissue

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So much individual variations…

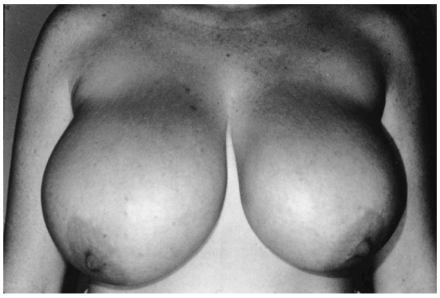
Breastfeeding Counselling: a training course, WHO/CHD/93.4, UNICEF/NUT/93.2

From Woman to woman…

- Breasts vary in color, size, shape and placement on the chest wall (genetically influenced)
- Lobular size differs within the same breast, from breast to breast.
- Left breast is often larger than right
- Areola and nipple differ according to race.

Freepik.com

Large breasts: hyperplasia



BF Atlas 2nd ed. 1013 h

Challenges for the mother (weight) and for positioning and latching the baby.

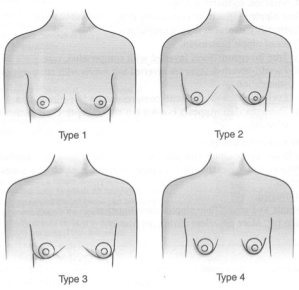
Small breasts

- Hypomastia: abnormal smallness of the mammary gland http://www.merriam-webster.com/dictionary
- Breast hypoplasia: underdevelopment of the breast. [Lawrence, p.41]

! Unusual shape: asymmetry, large intermammary space, tubular or conic shape, large areola compared to breast size.

The Breastfeeding Atlas

Breast hypoplasia: different types



Core Curriculum 12-7

- **Type 1**: round breasts, normal lower, medial, and lateral quadrants
- **Type 2**: Hypoplasia of the lower medial quadrant
- **Type 3**: Hypoplasia of the lower medial and lateral quadrant
- **Type 4**: Severe constriction, minimal breast tissue

Hypoplastic breasts

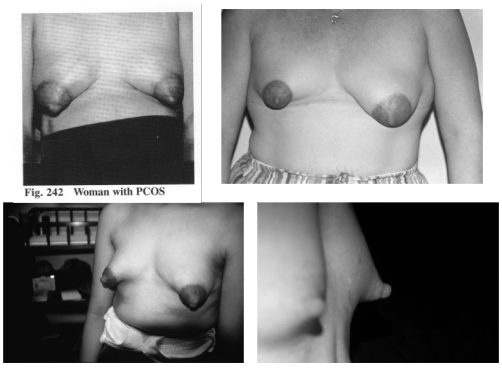
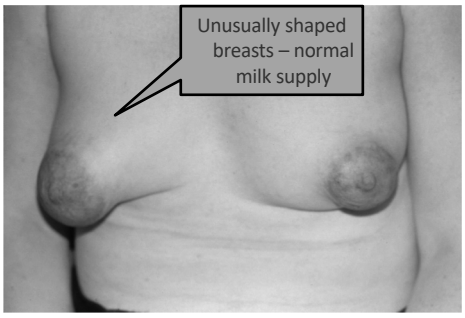


Fig. 242 Woman with PCOS

BF Atlas 2nd ed. : 1017, 1019, 1020 h

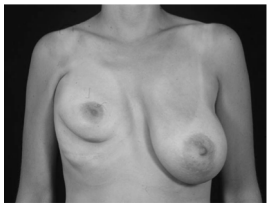
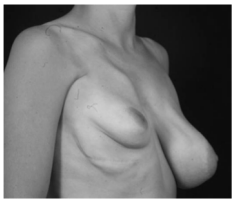
Impaired milk supply? Not always



BF Atlas 2nd ed. : 1018 h

Poland's syndrome

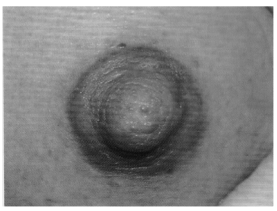
Underdevelopment or absence of the chest muscle (pectoralis) on one side of the body. Very rare...

https://en.wikipedia.org/wiki/Poland_syndrome

Areola

Areola size varies from one woman to another.



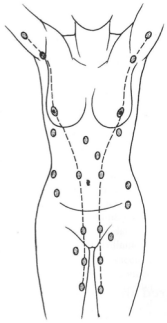
! If areola size large compared to breast size (not the case on the above picture).

BF Atlas Fig. 219, 221

Accessory Breast and/or Nipples

Supernumerary nipples, areolae, or breast tissue can develop along the milk line.
They can lactate or undergo malignant changes.

Lawrence 2-5



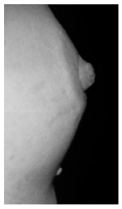
Lawrence & Lawrence

Ectopic nipples and areolae

Bilateral accessory areolae/nipples

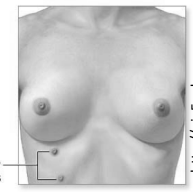
BF Atlas 1007, 1008h

Ectopic nipples

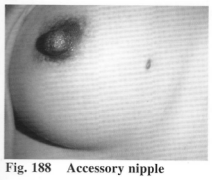


BF Atlas 1006h

Isolated nipples (also in males)



http://aia5.adam.com



BF Atlas Fig. 188 Accessory nipple

nairaland.com

Ectopic nipples within the main areola

'Double' nipples

BF Atlas 1007, 1008h

Ectopic nipples in the axilla

mydermpath.com

Radiographics
Figure 1a. Supernumerary nipples. **(a)** Photograph shows bilateral firm tan papules anterior to the axilla.

https://pubs.rsna.org/doi/full/10.1148/rg.275065142#F1A

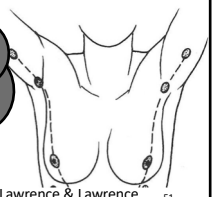
Which diagnosis?

Tail of Spence (part of the breast)?

https://www.semanticscholar.org/paper/Accessory-Axillary-Breast-Excision-with-Liposuction-Hwang-Choi/

Accessory breast tissue (separate from the breast)?

In both cases, the size increases with pregnancy and after delivery…



Lawrence 2-6

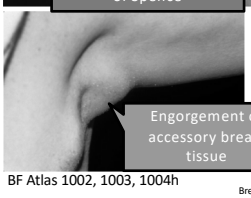
Lawrence 2-6

Lawrence & Lawrence

Similar clinical appearance…

Engorgement of the tail of Spence

Accessory breast tissue in the axilla (1 month postpartum)

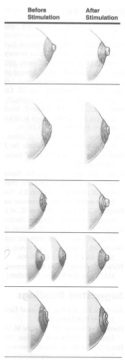


Engorgement of accessory breast tissue

But change of size after a feed occurs only with tail of Spence…

BF Atlas 1002, 1003, 1004h

Nipple variations



Core Curriculum 15-9
Lawrence & Lawrence

- **Common** nipple
- **Flat** and/or **Short shanked** nipple
- **Pseudo-inverted** nipple
- **Retracted nipple**: most common type of inverted nipple. Initially appears graspable, then retracts on stimulation. Responds well t techniques that increase nipple protrusion.
- **Inverted nipple**: retracted both at rest and when stimulated. Very uncommon.

N-B: More details in session on nipple conditions

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Thank you!

Breast development_LCTP_202