

Anthropology 3533

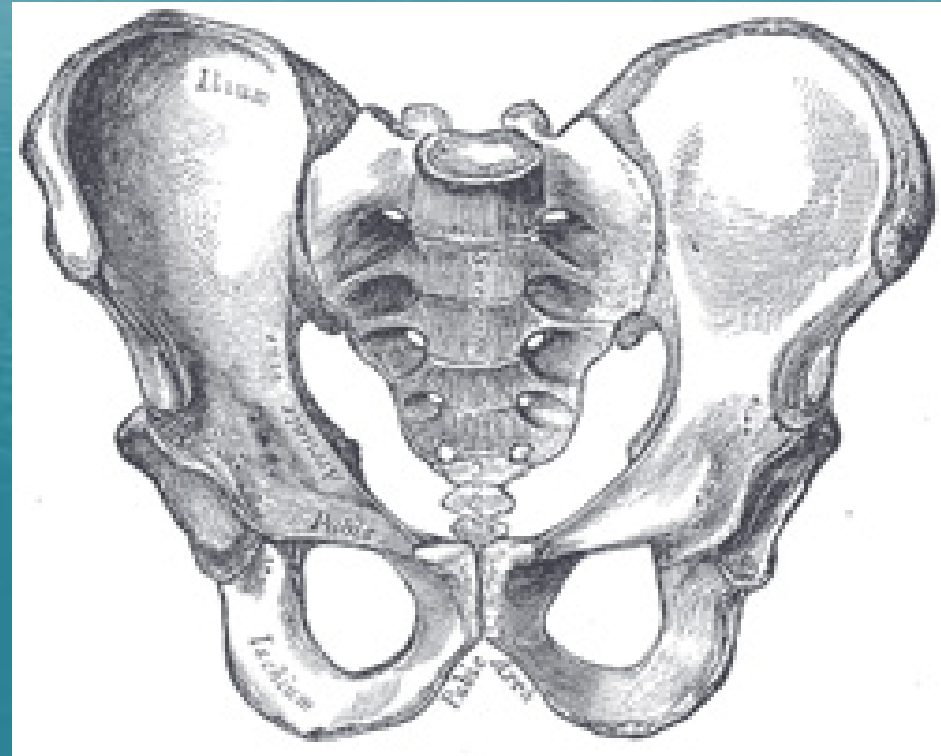
Week 4

Hominin Evolution and Birth

Modern Human Childbirth in Evolutionary Perspective

Introduction

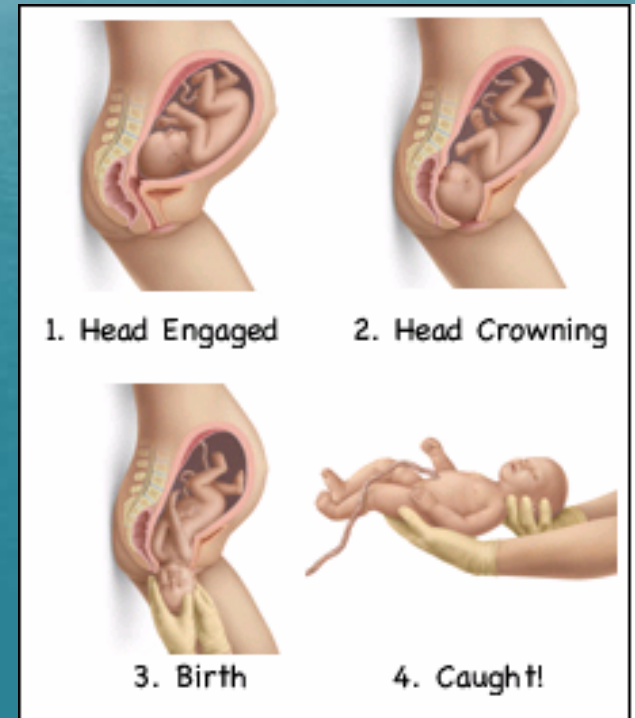
- A. Obstetrics, locomotion and posture in the pelvis
- B. Fetal Emergence in evolutionary perspective
- C. Hominins
 - A. Australopithecus afarensis
 - B. Australopithecus africanus
 - C. Neanderthals



Modern Human Childbirth in Evolutionary Perspective

To study the evolution of birth, we can compare human pelvic anatomy, patterns of locomotion, and birth with those of

- Extant primates
- Fossil ancestors



Modern Human Childbirth in Evolutionary Perspective

Last lecture we covered the “**Obstetrical Dilemma**”

Modern birth is a compromise between two selective pressures- bipedal locomotion and encephalization

Modern Human Childbirth in Evolutionary Perspective

Many features of pelvis shaped by these pressures

- Apes: pelvis anchors muscles of locomotion, serves as the fulcrum of the body
 - broad high pelvis
 - Narrow in width
 - Long flat ilia
 - Oriented coronally
- Humans: pelvis has to support viscera, attaches to abdominal muscles to support trunk, changes in gluteal muscles for supporting weight on one leg

Modern Human Childbirth in Evolutionary Perspective

Many features of pelvis shaped by these pressures

- Short broad, bowl-shaped ilia
- Bi-acetabular diameter
- Elongated pubic ramus
- Wide sacrum
- Broad lumbo-sacral angle
- Sacrum less curved

Modern Human Childbirth in Evolutionary Perspective

Diameters and size of pelvic inlet under strong selective pressure in human females

- A-P diameter of the pelvic inlet 10.5 cm
 - Diagonal conjugate somewhat wider
- Bispinale at midpelvis 10-10.5 cm
- Transverse diameter of outlet (bi-ischial) 11 cm
- Average diameter of human fetal head 10 cm

Modern Human Childbirth in Evolutionary Perspective

Modern non-human primate fetuses enter the birth canal, do not rotate, and then emerge facing mother

Human pelvis realigned such that widest dimension at inlet is transverse, widest dimension at outlet is anterior-posterior

Human fetus passes sacrum and pubis simultaneously at midplane

Human fetus must bend at outlet to emerge under the pubic bone at the ischial tuberosities

Modern Human Childbirth in Evolutionary Perspective



Bonobo



Gorilla



Orang Utan

Modern Human Childbirth in Evolutionary Perspective

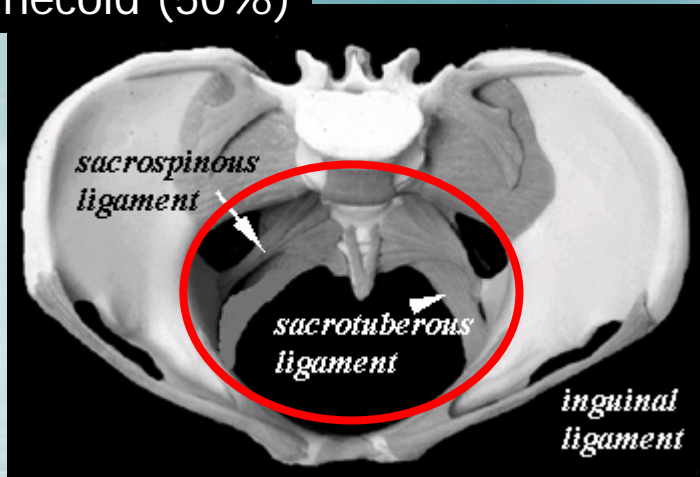


Human Female (left)
Human Male (right)
Common Chimpanzee (bottom)

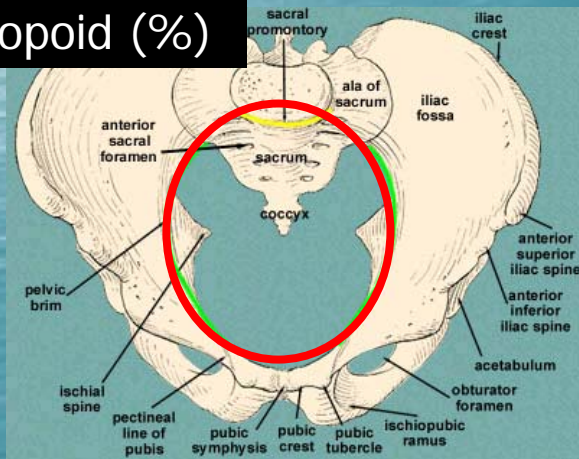


Modern Human Childbirth in Evolutionary Perspective

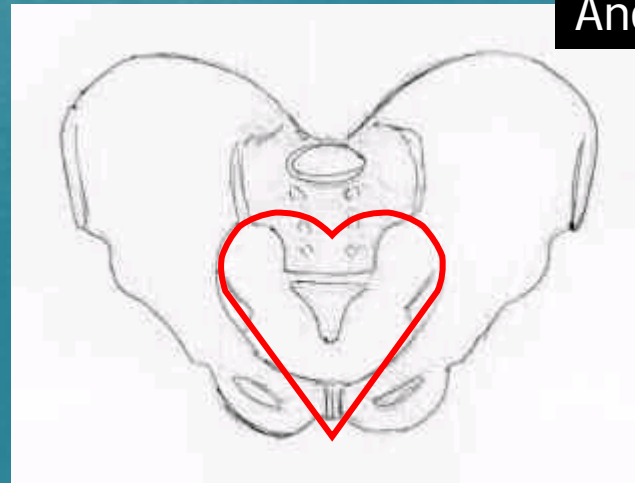
Gynecoid (50%)



Anthropoid (%)



Android (%)

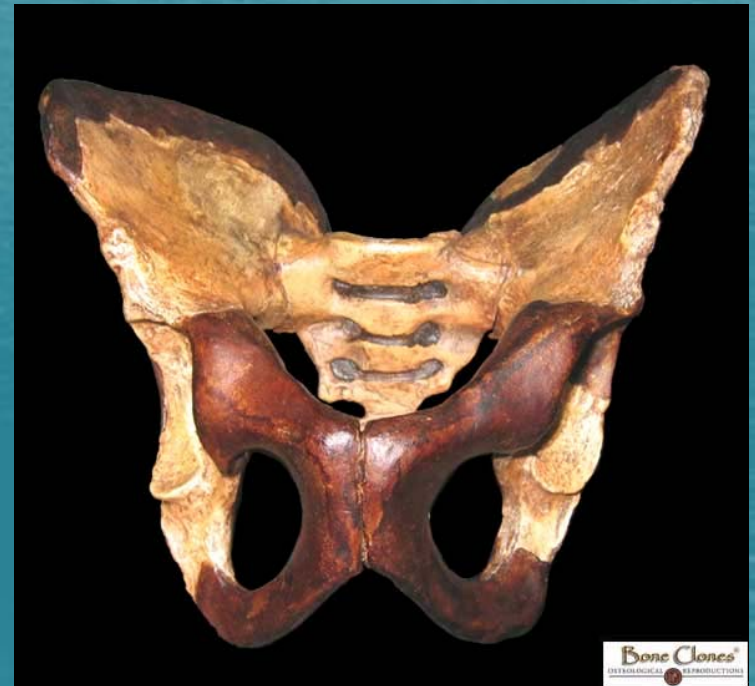


4 shapes to female inlet

Development may be related to activity levels in childhood, nutrition

Modern Human Childbirth in Evolutionary Perspective

- When did fetal rotation evolve?



Modern Human Childbirth in Evolutionary Perspective

- When did fetal rotation evolve?



Modern Human Childbirth in Evolutionary Perspective

- Dimensions of the pelvis play a role in determining gestation length for humans
 - Heterochrony: change in developmental timing that alters the size or form of anatomical structures
 - Modern human brain size too large to accomplish through only post-natal growth
 - Increased rate of brain formation during gestation results in higher Y-intercept for brain size for gestational age at birth
 - Human birth happens when infants are at a premature state in comparison with other primates, mammals “because” of brain growth rate
 - Neoteny
 - The trajectory of human growth may be slowed after birth
 - Results in longer, slower life history

Modern Human Childbirth in Evolutionary Perspective

Neanderthal brain size is comparable to modern humans
(average slightly greater)

Hypothesis 1: Neanderthals may have given birth to a more precocial neonate after a longer gestation time (11 months) to accomplish extra brain growth

Modern Human Childbirth in Evolutionary Perspective

Is gestation length actually correlated with pelvic dimensions in modern humans?

Diagonal Conjugate (max size of inlet)	< 10.5	10.5-11.5	11.5-12.5	>12.5
Sample size (# patients)	47	109	288	56
Average gestation (in lunar weeks)	39.2 +/- 3.1	38.7 +/- 2.4	39.4 +/- 1.3	39 +/- 3.3
Average birth weight (correlated with head diameter) in grams	3057 +/- 302	3290 +/- 177	3157 +/- 103	3102 +/- 314

Modern Human Childbirth in Evolutionary Perspective

Similar results for mid-plane and pelvic outlet

But lack of correlation between pelvic dimensions and birth weight not the same as pelvic dimensions and head diameter (even if there is a correlation between the two)

Modern Human Childbirth in Evolutionary Perspective

Are pelvic dimensions correlated with socio-economic status in modern humans?

Type of Patient	DC	Total pelvic score	Duration of Gestation	Birth Weight
Low SES	11.6	5.2	38.8 +/- 4	3081
High SES	11.8	5.3	39.7 +/- 4	3307

Modern Human Childbirth in Evolutionary Perspective

- Gestation length not determined by fetal head circumference or other size parameters
 - Only connection is that a large fetus in a mom with a large pelvis can be delivered vaginally
 - Even though it would be adaptive for a relationship between fetal size and pelvis size to exist, it does not
- Gestation length a complex phenomenon but mainly influenced by
 - Placenta health and morphology
 - The intrauterine environment
 - Whole biology and behavior of the mother

Modern Human Childbirth in Evolutionary Perspective

- Pregnancy usually does not last beyond 9 months
 - Limited life span for the placenta
 - Begins to degenerate around 9 lunar months
- when it does, the fetus does not benefit. Has higher risk of
 - Decreased fetal birth weight
 - Meconium
 - Infection
 - Death

Modern Human Childbirth in Evolutionary Perspective

- Neanderthals faced a similar challenge (encephalization vs. bipedalism)
- Kebara 2
 - 50-55 kya
 - Cave in Isreal
 - First complete inlet from Hsn
 - Male



Modern Human Childbirth in Evolutionary Perspective

Rak and Arensberg (1987)

superior pubic ramus is extremely long

size of the pelvic inlet is comparable to that of modern Homo sapiens

- Kebara 2 male pelvis only 2 cm larger in A-P diameter at inlet compared to modern human males
- Transverse diameter at inlet near the upper end of the range of variation for AmHs males

The longer superior pubic ramus (common in Neanderthals) is a result of an externally rotated innominate not from a larger pelvic inlet

- Long pubic bone related more to locomotion than obstetrics

Modern Human Childbirth in Evolutionary Perspective

Neanderthal Pelves in general have long superior pubic ramus

Neanderthal brain size is comparable to modern humans (average slightly greater)

Hypothesis 2: Long pubic bone length is an adaptation to birthing infants with larger brain size (increases size of pelvic inlet)

Modern Human Childbirth in Evolutionary Perspective

Tague (1992)

Restudied with a larger sample of modern humans

Found that Neanderthal pubic bone length is 2 sd above human median and does contribute to a roomier pelvic inlet (despite a narrower sacrum)

Modern Human Childbirth in Evolutionary Perspective

This week

1. We described possible adaptations in the physiological changes that women experience during birth, fetal behavior, hormonal and anatomical interactions between mother and fetus
2. Hominin evolution as a source of information about birth and pelvic morphology

