What does chimp Martial Arts demo have to do with bipedalism?

- Short legs
- Inflexible torso
- Pelvis structure & muscle orientation / function

Hip shape & muscles

Muscles contract along back
Leg swings back

Muscles contract along side
Leg swings out
OR...

Bipedal challenge

How to keep your balance on one foot?
- Hip muscles contract on weight-bearing side
- Avoid collapse to unsupported side

Flexible, S-curved lumbar spine
Built for bipedalism

Center of Gravity
- Short, stiff lumbar
- Tall, flat ilium
- Straight femur
- Angled femur
- Flexed knee
- Extended knee

Knee differences

Quadrupedal ape
- Vertical load equal on both condyles

Bipedal human
- Load heavier on outside condyle

Built for bipedalism

Center of Gravity
- Angled femurs
- Shock-absorber knees

Built for bipedalism

Flexible spine
- Hip shape
- Angled femurs
- Shock-absorber knees
- Shock-absorber feet

Built for bipedalism

Angled femurs
- Shock-absorber knees
- Flexible spine

Fossils

Clues to locomotor adaptations

The Dawn of Man
Early Australopithecines

Ancestral bipeds?

Later Australopithecines

Early Homo

Archaic Homo

Modern humans

**Sahelanthropus**

Skull base: upright posture?

Small brain

Canines

**Sahelanthropus tchadensis**

South African caves

East African Rift Valley

West African desert

7 MYR

Present
Ancestor?

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<tr>
<td>1</td>
<td>humans</td>
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<td>7</td>
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Tugen Hills
Kenya
Ororon
“Millenium Man”
6 mya

Bipedal Ancestors?

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A "missing link"?

chimp

human

Small brain
Upright
Medium canine
Thick enamel

A "missing link"?

chimp

human

Humerus

Bipedal femur?

Teeth?

Ardipithecus ramidus
“root ape”
Aramis site, Ethiopia

Ardipithecus

Sediments 5.8 - 4.4 mya

Bipedal toes!

Opposable big toe
Chimpanzee foot
Human foot

A "missing link"?

Chimp-like teeth human

Bipedal toes...?
**Ancestral bipeds?**

<table>
<thead>
<tr>
<th>Locomotion</th>
<th>Brain</th>
<th>Canine</th>
<th>Molars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upright, Bipedal toes</td>
<td>?</td>
<td>Pointed, projecting</td>
<td>Cuspy, Thick enamel</td>
</tr>
<tr>
<td>Bipedal thigh?</td>
<td>?</td>
<td>Pointed, projecting</td>
<td>Low cusps Thick enamel</td>
</tr>
<tr>
<td>Upright posture?</td>
<td>Ape-sized</td>
<td>Pointed, projecting worn</td>
<td>Low cusps Thick enamel</td>
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**“Ancestral bipeds?”**

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<td>Ardipithecus</td>
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<td>Orrorin</td>
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<td>Sahelanthropus</td>
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</table>

**Australopithecus anamensis**

**Human family**

**Limb bones = biped!**

- Arms & hands for climbing
- Knees for bipedal walking

**NEW DISCOVERIES**

Kenya fossils 4.1 mya
Knee of *A. anamensis*

Elbow joint
- Long arms & grasping hands
- More flexible than knuckle-walker

Elbow Connections
- Chimpanzee Humerus locks in place for stability
- Anamensis and human arms are more flexible

Projecting face & Crushing teeth

<table>
<thead>
<tr>
<th>Early australopithecines</th>
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<tbody>
<tr>
<td>present</td>
<td>humans</td>
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<td>Australopithecus anamensis</td>
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<td>Ancestral bipeds?</td>
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</table>
2 sites
Same species
3-4 mya

Who made the footprints?
Hadar, Ethiopia

Best fossils of *Australopithecus afarensis*

“Lucy”

Rocking the anthropological world, a second “Lucy” is discovered in southern Ethiopia.

Long arms & fingers.

Chimp.

australopithecus

chimp

human
Hip: oriented to side
Knock-kneed

Small brain
Projecting snout
Small canine
Hominid molars

Walking the walk

South African australopithecines

Early australopithecines

present

1
2
3
4
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7

myr

humans

Australopithecus anamensis
A. afarensis
Ancestral bipeds

present

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MYR

Lucy skeleton

Ancestral bipeds?
**Early australopithecines**

- **East Africa**
  - 4 - 3 mya

- **South Africa**
  - 4 - 3 mya

**Skeletons in caves**

Skeleton of "little foot"

**Human lineage**

- Present

1. Early Australopithecines
   - Habitual bipeds, climbers, mixed diet?
   - Ancestral bipeds?

2. A. afarensis
3. A. africanus
4. Australopithecus anamensis
5. Ancestral bipeds?
6. Modern humans

**Early australopithecines**

- **Primitive traits:**
  - Ape-sized brains
  - Projecting face & broad incisors
  - Climbing abilities
  - Body size dimorphism

- **Derived traits:**
  - Smaller canines
  - Crushing molars
  - Effective bipeds